MODERN BUILDING TECHNIQUE

DOMESTIC & SIMILAR STRUCTURES

By
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With a Foreword by
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FOREWORD

AS a result of scientific investigation carried out in recent years in this and other countries, we know very much more than we did, say, twenty years ago, about the properties of building materials and methods of construction. Reasons for troubles that occur from time to time have been made clear and suggestions for avoiding them advanced. It is obviously desirable that as soon as the new information has been sifted and tested, it should be expressed in terms of day-to-day practice so as to promote its effective use. The scientific worker is not always the best person to do this. From the nature of his work he may not be able to combine in himself both the specialist scientific knowledge necessary for the conduct of research and the intimate familiarity with everyday practice which is necessary to make the work of interpretation effective. Indeed, there may well be several stages in the translation of the written record of scientific work into a statement of conclusions in terms of practice. In this process qualified men engaged in the industry must play their part.

It is for this reason that volumes such as the one now presented by Mr. Gunn are so much to be welcomed. He has evidently made an extensive study of available scientific information and turned his experience in practice to good purpose in applying it to domestic construction. As one who has been engaged now for a good many years on the research side, I have a lively appreciation of the difficulty of presenting results in a form which will "get them across"; and scientific workers generally must welcome the co-operation of those who, like Mr. Gunn, combine a critical appreciation of the results of research with thorough knowledge of practice and who are, therefore, well qualified for this task.

While I cannot lay claim to the author's intimate practical knowledge or even pretend to be able to express any opinion on all the suggestions advanced, it seems to me that the volume represents a welcome contribution to the advance of building construction.

R. E. STRADLING.

INDEX to SECTIONS

PREFACE

Precise comparative figures of the amount of constructional work proceeding at any time in this country may be hard to come by, but there can be little doubt that the vast bulk undertaken since the war, both as regards extent and value and the number of workmen employed, has been in the construction of the small house—" Everyman's House," to use the descriptive phrase of the furnishing firms. In the general and detailed construction and fitting up of such houses, similar problems and opportunities constantly recur and are either solved, evaded or ill-treated according to the degree of knowledge, experience or ingenuity of the individual in control.

It may seem curious, in view of the volume of building of this class, that there appears to be no reference work specifically devoted to it. Obviously such a volume might treat in greater detail and with more particularity than would be possible in a more general work, with the problems occurring within this narrow field; and the aim of the present series will be to provide information which should be directly useful in such application. In compiling these chapters, endeavour will be made to include the results, not only of personal experience in this field, but references to apposite material arrived at (by investigation, research and collaboration) by such bodies as the Building Research Station, the British Standards Institution, and the Building Industries National Council. Sketches will be introduced wherever necessary to elucidate particular points, and as the aim of the work is purely practical, with no thought of such incidental objects as the satisfaction of examiners, they can be devoted strictly to their immediate purpose.

To preserve some sort of order in the series, the British Standard *Sequence of Trade Headings and Specification Items*[1] will, as far as possible, be adhered to, and references to cost will assume work to be executed in districts graded " A " for building wages. By relating the figures to other building wage grades appropriate adjustment may be made for any given graded area, though it will no doubt be fully understood that all prices quoted without reference to a particular situation and time can claim to be no more than generally indicative of proportional cost and must not be taken as absolute.

1 *British Standard Sequence of Trade Headings and Specification Items for Building Work.* B.S.I., 28 Victoria Street, London, S.W.1. No. 685. 1937. Price 2s net.

EXCAVATOR

CLEARING SITE

This item is far too often taken so literally that a site which might have retained original or acquired features which would give some interest to the completed building are ruthlessly removed. Trees, saplings or hedges not actually in the way of projected buildings or drains need not be felled or uprooted, and it is not necessary to level all banks, mounds or other inequalities not directly under the site of the building, which often would afford a basis for garden-design to remove the work from drab uniformity such as disfigures for a time any " developing " district.

PROFILES

The general outlines of the plan should first be carefully set out, using the system of " profiles " marked by pegs and boards (Fig. 1), upon which the overall thicknesses of walls and partitions are defined by saw-cuts in which lines may subsequently be fixed for the guidance of the excavator and bricklayer. It is well not to skimp these board profiles, as they afford a useful field for the noting of particular points.

SURFACE EXCAVATION

Having set up profiles, the next item in order is soil-stripping, which should cover the whole area within the outer line comprising the foundation-spread. The top-soil removed should be wheeled directly to positions where it will be of use for garden-making, not necessarily all stacked in one heap. In some cases turves may be cut within this area

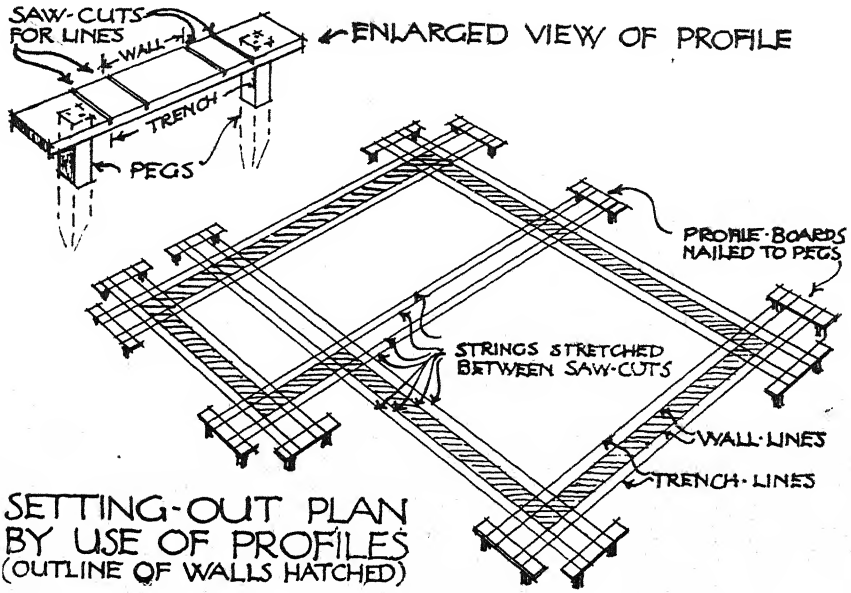


FIG. 1

and for some 5 feet around it, to which distance any turf existing will certainly be destroyed by building operations.

TRENCH EXCAVATION

It would be futile to attempt to lay down rules of general application as to width and depth of foundation trenches, even for so nearly standardised a type as the average small house. The following general considerations may, however, usefully be borne in mind.

There is no magical quality in concrete, which depends for its reliability as a foundation material either upon reaching a sound bottom as a continuous base or in a series of pillars, or upon spreading the area upon which the superincumbent load is borne so that it will be within the supporting capacity of a compressible soil. The assumed bearing capacities of the most commonly found subsoils and foundation materials in this country are well known, but for convenience of reference may be quoted:

Tons Per Square Foot Safe Load.	Tons.
Rock (average)	3
Moist clay or sand	1.36
Dry clay	2.25
Stock brickwork in mortar ...	1.82
„ „ „ cement ...	8
P.C. concrete, 1 : 6	15

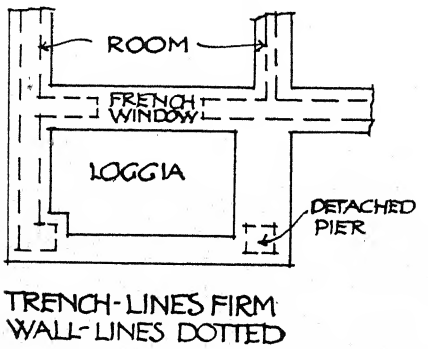


FIG. 2

Concrete foundations fulfil another function in equalising pressure laterally along the length of a wall so that weight concentrated on piers between openings such as doorways and windows may be distributed along these spaces or voids. For this reason, wherever some degree of compressibility exists in the soil, the temptation to interrupt the continuous foundation across openings should be resisted—trenches should be continuous along the line of walling, and isolated piers such as may occur at the angles of a projecting loggia should be united by foundation to the adjoining structure (Fig. 2).

FORMING EMBANKMENTS OR TERRACES

On sloping sites where the ground floor is necessarily either dug in or elevated on one or more sides, or more usually averaged between the two, the excavated material is most economically disposed of by the formation of slopes or terraces against the lower side of the site. The tendency of such deposited formations to settle or slip away must never be overlooked, and, apart from supplementary support, the usual angles of repose of soil must be observed. These are taken to be:—

Clay, dry 29°, wet 16°
Earth, dry 29°, wet 17°
Gravel, clean 48°, sandy 26°
Sand, fine dry, 31°, wet 26°
Shingle, loose, 39°
Peat ... 14° to 45°

Apart from these natural angles, earth laid on a slope is always subject to the scouring effect of rushing water in times of heavy rainfall. This has, of course, greater effect on loose formations such as sand and earth than upon heavy, dense or fibrous substances, and the volume of flow is also important. For these reasons it

is useless to suggest a definite angle of repose for cultivated topsoil, which will rely chiefly on a combination of absorbency and vegetation for its holding-power.

WATER IN TRENCHES

Few building sites which are *absolutely* level will be met with. Usually the bottoms of foundation trenches are necessarily benched in 3 in. or 6 in. drops trending to one corner—to which any soil or surface water which may enter will gravitate. If the quantity is likely to be considerable, it is worth while to cut a narrow trench from this point either emerging at the surface (if slopes favour) or to a drainage sump slightly deeper than the trench so as to run off the water which otherwise may fill the trenches, softening the bottoms and possibly causing falls of earth from the trench sides. More extensive works, such as timbering and pumping, will be very infrequently required in the class of work under discussion.

CONCRETOR

MATERIALS

Anyone having occasion to employ concrete will be better fitted to do so after perusal of the booklets issued by the Cement and Concrete Association dealing with every common application thereof.[2] In the modern use of concrete, builders possess advantages over their forerunners from the greater knowledge of the properties, behaviour and (consequently) desirable composition of the material, due to the research work of the B.R.S., B.S.I., and the large cement makers, and both waste and occasional failure should now be quite readily avoided.

Concrete is made by binding together, by means of Portland cement and water, particles of sand and gravel, broken stone, or other substances known as aggregate. The term "aggregate" is somewhat loosely used: sometimes it refers to the coarser particles of the material as distinct from the sand; but, strictly speaking, it includes the sand, which may be described as the finer aggregate, the whole of which is generally less than ¼ in. in diameter.

The correct proportions of water, cement, sand and coarse aggregate depend on the nature of the work for which the concrete is intended, and on the character and condition of the sand and coarse aggregate. As to the nature of the work, in ordinary house construction concrete will commonly be employed in three directions: (1) as trench foundation; (2) as paving or oversite layer; (3) in reinforced concrete lintels — occasionally combined with projecting hoods or balconies. As to the character of the aggregate, it is the chief claim to economy of concrete work that by use of local aggregate transport and handling charges on bulk material may be largely reduced. It is therefore advisable to seek local material adequate for the work in hand, possibly with some abatement from the ideal which may be essential to the production of "perfect" concrete suitable to highly-stressed reinforced construction.

2 *Concrete—How It Is Made.* Free, from Cement and Concrete Association, 52 Grosvenor Gardens, London, S.W.1.

CEMENT

The most important ingredient of concrete is, of course, cement, which is also the most expensive. It is, therefore, essential to economy that cement should be so proportioned to the other materials that excess is avoided, the aim being that (in work intended to be impermeable or free from a tendency to "dust-up") all voids are filled and every particle of aggregate coated. Portland cement should comply with B.S.S. No. 12, and as it is now usually supplied in paper bags containing 1 cwt. it is convenient to mix batches of concrete proportioned on a bag basis. The table on next page, based on information given in the booklet referred to, is a handy one for reference.

The proportions given are based on cement weighing 90 lb. per cubic foot; damp sand well graded, 84 lb. per cubic foot; and coarse aggregate to gauge specified, 90 lb. per cubic foot. The quantity of water is the actual Imperial gallons to add per batch, and should not be exceeded with any idea of making a more workable mixture.

VARIETIES OF AGGREGATE

The aggregates suitable for making good concrete are granite, gravel, graded ballast, and crushed stone; but clinker, broken brick or coke-breeze may be used for certain restricted purposes, provided care be taken to see that they contain no deleterious matter, such as unconsumed particles of coal or adherent gypsum plaster. For waterproof concrete the aggregate must, of course, be impermeable, and for surfaces to resist abrasion (notably paving), a hard aggregate should be used. The size of the largest particles used should never exceed one quarter the thickness of the work, and should be smaller if reinforced work is in question.

CHOICE OF AGGREGATE

While it is obvious that in order to produce comparable results for scientific tests certain aggregates of known good qualities, such as clean Thames ballast, and Leighton Buzzard sand, must be uniformly employed, the general adoption of these materials as standard is not necessary, and may have evil consequences, such as follow unthinking adoption of "best Countess" as a nearly invariable description for slating. In most cases, each locality will furnish a material which, suitably used, will make good concrete suitable for the ordinary purposes of building, keeping in view the differing requirements of the three main classes of employment already named.

Cement and concrete tests have in the past rather tended to concentrate on compressive strength, to the neglect of qualities even more important in practice as regards many fields of employment—e.g., resistance to abrasion or impact (for paving), transverse strength (for lintels and slabs), absorption (for surfaces exposed to weathering), and the general question of durability. Some of the later B.S.S., such as No. 368, dealing with concrete flags, include specified tests from these important aspects. Speaking generally, and subject to the exercise of common sense in choice so as to exclude obviously dirty or ungraded samples, local aggregates as under may be taken as suitable in their several classes for house-building.

(1) *Mass concrete in footings.* Any form of *shingle* (rounded waterworn stones) with addition of sand where necessary to fill voids. Sea, river or pit ballast may alike prove suitable, a taint of salt is unimportant in this application.

Crushed stone or granite (excepting some varieties of dolerite[3]) subject to

3 Dolerite, which is usually classed as whinstone, from its hardness and apparent soundness, appears eminently suitable, but some varieties may completely disintegrate on exposure and are dangerous in use, *vide* warnings issued by the Cast Concrete Products Association.

HAND-COMPACTED CEMENT CONCRETE—PROPORTIONS.

Mix	Cement	Sand (damp)	Coarse Agg.	Water
Mass concrete in footings which need not be watertight ...	1 bag (cwt.)	4 cub. ft.	6¼ cub. ft. 2 in. max.	5½ gall.
Oversite or paving to be finished with other surfacing (e.g., screeding or tiles) ...	1 bag (cwt.)	3¼ cub. ft.	5 cub. ft. 1½ in. max.	5 gall.
Reinforced lintels, hoods, watertight floors, pavements or walls	1 bag (cwt.)	2½ cub. ft.	3¾ cub. ft. ¾ in. max.	4½ gall.

freedom from dust and to the presence of a fair proportion of finer particles.

Clean broken brick of well-burnt character free from mortar fragments or plaster.

Well-burnt clinker free from unconsumed coal or rubbish.

(2) *Oversite or paving* to be finished with other surfacing. Shingle or stone as above, provided that if porous aggregate is used care must be taken to see that it is kept moist when the surfacing is applied.

(3) *Reinforced lintels* and similar things requiring to be watertight. Any of the above materials of angular form, low absorbency, and well-graded assortment of size; i.e., rounded pebbles or porous clinker aggregates are unsuitable, but the former may be rendered so by crushing.

MISTAKES IN MANIPULATION

Defects or failures in concrete work are commonly traceable to one or more of the following causes :—

(1) The use of too much or too little water during mixing, or water carelessly applied.

(2) The incomplete incorporation of the aggregate with the cement.

(3) Using concrete which has already begun to set.

(4) The placing of concrete on dry foundations without thoroughly saturating their surfaces.

(5) The use of dirty aggregate, or water containing earthy matter, clay, or loam.

(6) The repeated " floating " or trowelling of concrete surfaces.

(7) Insufficient curing.

CONCRETE IN TRENCHES

Economy in time and materials, and a more evenly reliable product, results from the use of a mechanical batch mixer. Proportions may be as given in the preceding table. Concrete should be deposited in place within half an hour of mixing, and should not be shot from a height, which causes the ingredients to separate, leaving the cement and fine particles on top. Both upper and lower surfaces of foundation concrete should be *level*; the trench-bottoms should be carefully benched, and the thickness of concrete defined by pegs driven in and used as a guide for the upper surface. Benchings of the bearing surface are conveniently formed by setting the requisite number of brick courses at each drop (Fig. 3).

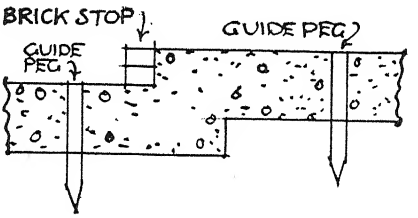


FIG. 3

Raft Foundations are economical where a sound foundation exists only at considerable depth, or for light buildings on clay soil.

Where reinforced raft foundations are employed, several problems arise. The chief of these are :—

(1) Provision of a clean working surface. This is best achieved by the laying of a thin concrete " carpet," say, 2 in. in thickness, of weak concrete—say, 8 : 1—as a preliminary to the structural raft.

(2) Disposition of damp-course in external walls, so as to be effective in the base of the inner skin (cavity walls assumed).

(3) Treatment of the " spread " of the raft beyond the wall face, which is an essential to the raft's function. These two problems together suggest a design on the lines of Fig. 4.

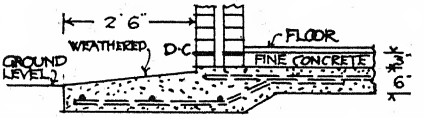


FIG. 4

(4) Effective junction of raft if the whole cannot be continuously formed in one operation. This involves the projection of reinforcing material and treatment of the free edge of the executed portion of concrete by hacking and coating with rich cement slurry as a preliminary to continuation of concreting.

OVERSITE CONCRETE

Bye-law requirements in some districts prescribe a thickness of 6 in. of cement concrete over the whole area enclosed by a house wall; in others, a thickness of 4 in. is deemed sufficient, while others dispense with this provision. However dry and porous the subsoil, a layer of sealing material is advisable. The level at which it is placed depends on the nature of the floor finish; if it is joists and boarding, the oversite is laid upon the natural ground level as exposed by soil-stripping; but if wood-blocks, tiles, lino or cement flooring is intended, the level must be raised to form a base for this finish. A frequent cause of penetration of dampness from the ground arises where change of level so caused is not guarded by vertical damp-proofing. (Fig. 5.)

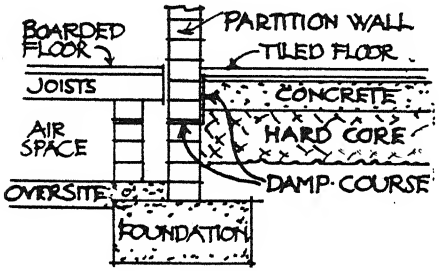


FIG. 5

Where oversite concrete is to form the base for any solid floor (i.e., where no air-space is formed), the warmth and dryness of the floor will be greatly improved if the filling beneath is of coarse hard core firmly but loosely packed so as to preserve internal voids —3 in. of good concrete over 6 in. or more of clean hard core is preferable to 6 in. of concrete.

The thickness of oversite concrete is usually determined by setting wood pegs in the levelled earth surface by which the level of the finished layer is gauged. It is vitally important that all such pegs should be driven down through the layer and effectually sealed over with concrete after the general layer has been placed; otherwise they may form a starting-point for dry-rot fungus which may destroy wood flooring (Fig. 6).

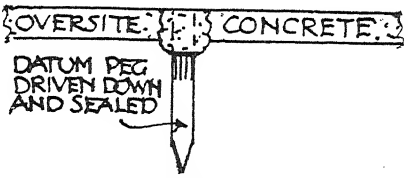


FIG. 6

The stage in a building's progress when oversite concrete is laid has some importance. If it is laid as soon as the main walls are raised above the ground level (preferably *before* the damp-course is laid) the wheeling and spreading of the concrete can be more easily performed than if it is deferred until doorways and openings must be negotiated, and, moreover, a clean working surface for future operations is provided within the walls.

A damp-course laid and left exposed during this operation will almost certainly receive accidental damage which may escape attention.

PAVINGS

Concrete pavings which are to be surfaced in terrazzo, granolithic or other mixtures of cement and fine aggregate must have provision for expansion and contraction if the areas exceed about 36 ft. super—otherwise cracks, which may be unsightly, are almost sure to develop. The best means of securing such provision is to lay the flooring in panels of less than maximum size, " leapfrogging "

intervening spaces, which can be filled in afterwards, inserting strips of bituminous roofing felt, or special expansion strips, between the joints (Fig. 7).

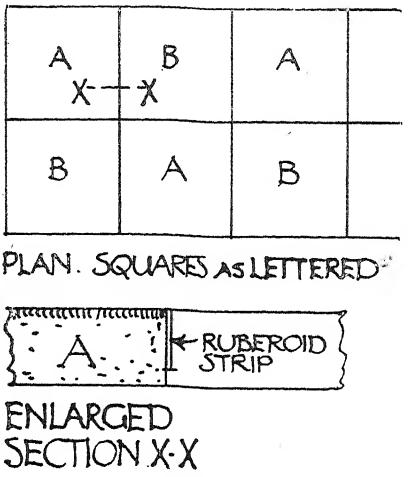


FIG. 7

All external pavings, and some internal ones, should be laid to slight falls so as to facilitate quick drying and prevent the easy formation of pools.

CONCRETE LINTELS

Cast concrete lintels have almost wholly ousted the one-time wood or stone lintel for spanning door and window openings in domestic work. They may be either formed *in situ* or precast, the choice depending largely on the size and consequent weight of the finished product, and sometimes the nature of the external facing.

Lintels cast *in situ* are almost inevitably solid (without cavity) and in substance must be, in consequence, waterproof. In this case they are dense, and if exposed or merely plastered internally will be subject to atmospheric condensation of moisture, which is likely to be mistaken for penetration of damp. They do, however, permit the attachment of brick facings as shown in Fig. 8, which preserve the continuity of surface

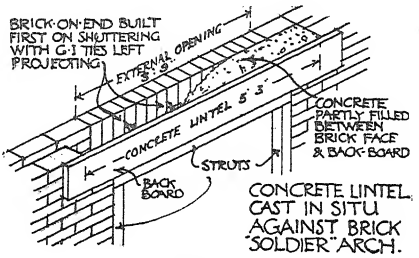


FIG. 8

almost essential to brickwork design. Many an otherwise pleasing brick building has been ruined in appearance by crude concrete lintels.

Precast lintels in cavity walling can be separated by the cavity, thus preserving the disconnection it affords. Some means of distinguishing top and bottom is a necessity, so that the reinforcement may occupy the correct position when the lintels are fixed. The formation when casting of a weathering or lip on each lintel as in Fig. 9 not only fulfils this purpose, but also serves as a hood or "drip" externally and as a distance-spacer for the inner lintel.

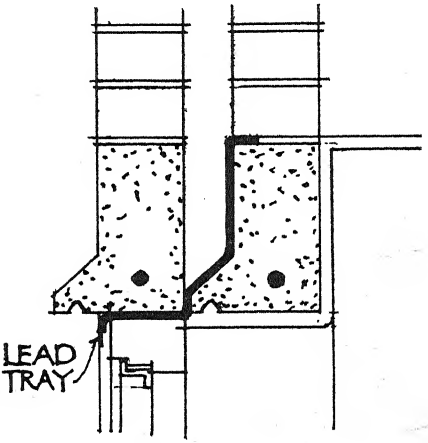


FIG. 9

REINFORCEMENT

Some curious materials are commonly used as reinforcement by

builders of domestic work. Old bed-frames and disused gas-barrel are not infrequently found in lintels, and they appear to serve their purpose, though their "life" may be uncertain. It should not be forgotten that the materials more regularly specified and employed have formed subjects for B.S.S.; No. 405 deals with expanded metal, and No. 165 with hard-drawn steel wire for concrete reinforcement.

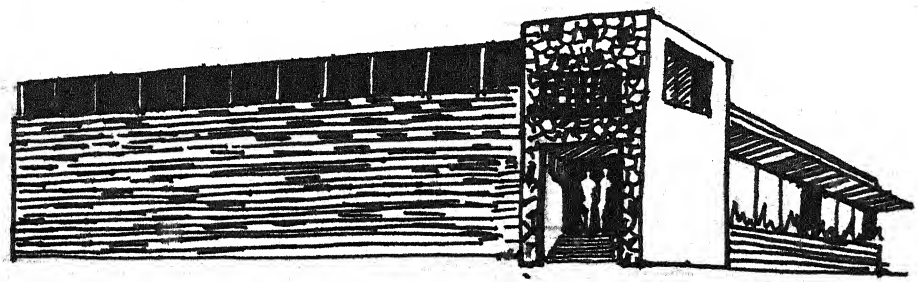
DEFECTS IN CONCRETE WORK

A great deal of useful and detailed information as to the causes and cures for defects in concrete work appears from time to time in the "Questions and Answers" issued by the Building Research Station. Within the field covered by these notes, the following can so far be included:

Cracking of Monolithic Concrete Walls	Series I, No. 2
Causes of Inferior Floor Finish	... Series I, No. 115 and Series III, No. 226
Heat Expansion of Concrete Roofs	... Series II, No. 28
Concreting in Cold Weather	Series III, No. 163
Decay of Reinforced Concrete Building	Series III, No. 204

COST OF CONCRETE WORK

	Per yard cube
6 : 1 work in foundation trenches; 2-in. ballast aggregate	18s.
6 : 1 work spread and levelled over surface	19s. 6d.
4 : 2 : 1 spread and levelled for paving 6 in. thick	4s. per yard super
4 : 2 : 1 with $\frac{3}{4}$-in. ballast aggregate in lintels, etc.	1s. per foot super
4 : 2 : 1 with $\frac{3}{4}$-in. ballast aggregate cast in lintels	$4\frac{1}{2}$ in. by 6in., 11d. per ft. run
including $\frac{1}{2}$-in. steel rod every $4\frac{1}{2}$ in. in width	9 in. by 6 in., 1s. 6d. per ft. run
and all formwork complete ...	$13\frac{1}{2}$ in. by 9 in., 2s. 6d. per ft. run



BRICKLAYER

GENERAL

This trade is normally the most important in two respects. In cost it bulks heavier than any other, usually amounting to about one-seventh of the total cost of a house, and if improperly directed, its defects are most difficult to rectify.

MATERIALS

The materials of the bricklayer—bricks and mortar—require more consideration than is often afforded them. It is obviously impossible to include notes on the ordinary building-brick which would be equally applicable to the common brick of every locality, such as the house-builder of economical intention must employ; but a few general notes on the several materials alone and in conjunction may be of service.

BRICKS

Standardisation of size of ordinary building bricks is obviously desirable if different varieties are to be used in the same work. This task has recently been taken over by the B.S.I. from the R.I.B.A., who initiated it many years ago, and in B.S.S. 657 the standard sizes are defined. It is perhaps worth while to give the reasons which appear to have led to the general adoption of brick sizes, which are of so common adoption in civilised countries. The governing factors are both human ones—the span of a man's hand will comfortably grip a solid object 4 in.-4½ in. wide, and his muscles will continuously lift, adjust, and place units between 6 and 7 lb. in weight through a working day without undue fatigue. The customary dimensions of the common brick—roughly, 9 in. x 4½ in. x 3 in.—arise naturally from these simple facts, in conjunction with the desirability of factorising so as to secure easy bond; the brick expressed as a proportion is 6 : 3 : 2, the common factor being 1½ in.

The varieties of brick in use locally differ vastly in quality and substance, ranging from the clamp-burnt stock—still produced in the neighbourhood of Slough and in numerous Kent, Sussex and Essex fields, to the wholly machine-made semi-dry or stiff plastic products of Peterborough, Bedford, Yorkshire, and several southern and western centres. Many of the latter are necessarily reduced in weight by the formation of deep single or double frogs or by perforations.

CHARACTERISTICS OF A GOOD BUILDING BRICK

The characteristics of a good building brick (apart from colour and texture which are desirable for exposed brick facings) are soundness arising from suitable material and thorough burning; good shape, involving truth of line and dimensions and retention of arrises and angles; ability to be cut and shaped by the bricklayer without undue waste, involving a certain degree of mildness; and a degree of porosity capable of exerting some measure of suction on mortar and plaster, so that these may combine in a homogeneous structure. If, in addition, colour and texture are good, it is an added advantage which will permit the brickwork to remain exposed, and thus effect some saving in first cost and maintenance. Bricks of an unpleasant, even, liver-like red, or a pasty pinkish blotched appearance,

are best hidden beneath plaster or roughcast, or coated with limewash, distemper, or slurry, and it is fortunate that in many districts where such bricks are now the common resource, plastered houses are traditional. Not so fortunate, however, is the fact that without artificial aid such bricks do not usually afford the best basis for plaster or colour-wash, the former being apt to fail in adherent quality, and the latter to wash off in driving rain. To meet the trouble in adhesion, makers usually produce grooved or slotted bricks, which it is advisable to use wholly or in part beneath plaster or roughcast, while to provide a texture to which colour -wash will bind, roughened surfaces are also commonly made. Failing their provision by makers, an added surface retentive of limewash or distemper can be produced by a preliminary coat of " Supercement " slurry laid on and allowed to set hard.

Cement bricks and sand-lime bricks are comparatively recent additions to the builders' resources, though the latter have been subject to a B.S.S. (No. 187) for some years past. They are quite reliable when properly made, and their extreme regularity of shape makes them easy to use.

CHOICE OF BRICKS FOR APPEARANCE

Fortunately, that distressing period when the aim of the maker of facebrick was to produce uniformity of colour—a hot red—has passed. In those days it was no uncommon thing to see Surrey houses faced on their " fronts " with these bright red horrors, while less important parts were built in the lovely (but unesteemed) plum-colour and silver-grey stocks which local yards produced. Not every district, however, is as fortunate in its product as, say, Surrey or Berkshire, and where it is economically necessary to use available materials lacking the pleasing colour variations and surface texture of such favoured districts, the best must be made of them. A few hints may be helpful.

First, on the practical side, the aim should be an approximately equal degree of porosity for bricks and jointing. A dense, non-absorbent brick jointed in porous mortar results in undue absorption of rain by the joints, which may even show as a pattern on the inner wall face, if solid. On the other hand, bricks of open, porous texture having joints of dense cement mortar tend to localise penetration, which otherwise may distribute itself harmlessly by " blotting - paper " soakage.

COLOUR OF BRICKS

The fashionable *multi-colour bricks* perhaps now tend to be *too* multi-colour, in which condition they may be toned down by wide joints, ½ in. or more, of light-coloured mortar. Crudely *red bricks*, however, lose some of their garish effect if the joints are well raked or pressed in—particularly the horizontal joints. This is particularly noticeable in Alfred Waterhouse's last Prudential Building in Holborn, where smooth red " terracottta " bricks are used.

Grey bricks, whether like the purplish-grey of Luton, or the silver-grey of Reading or Ruabon, seem to need a warm, yellowish joint not too prominent or wide; about ¼ in. and pressed in or struck. *Yellow stocks* were, perhaps, better understood and treated by Beresford Pite than by most later users. To walk round the back streets of Marylebone and observe his use of them is an education in their possibilities. By occasional bands of Luton greys—not proclaimed, but blending—he imparted colour and relieved drabness, while later, in his church at Brixton Hill, he went even further with horizontal joints so far recessed that they appear quite open. The dark *Black Country bricks*, virtually a second quality blue Staffordshire, look fine when flush-

jointed with about ¼-in. joints in light grey, as can be seen in the newer embankment walling of the G.W.R. line to Greenford around Acton, where it leaves the old main line. This subject of relationship of brick, mortar colour and form of joint is worthy of close study every time.

MORTAR

Mortar is a component no less important than bricks in the composition *and colour* of the finished wall. Every architect can recall instances where expensive facing bricks have been utterly ruined in appearance by unhappy jointing, and, conversely, where common brick has owed eventual pleasant appearance to wise choice in this respect.

Mortar, like concrete, consists of cement and aggregate—lime and sand. Recent experiments by B.R.S. have tended to clarify the position as to the desirable qualities of mortar to be used in setting brick and stone. The hard, dense mortar produced by admixture of Portland cement and sand, while admittedly strong and weather-resisting, is said to lack the good qualities of lime-mortar in some important respects, chiefly due to its inevitable shrinkage in drying, which leaves fine interstices between vertical joints and adjacent brick faces, which are then the source of moisture penetration by capillarity. The question is fully discussed in B.R.S. Questions and Answers, 3rd Series, No. 183, where the recommendation (applicable to London Stocks) is made that mortar compounded one Portland cement, three non-hydraulic or Greystone lime, and ten to twelve sand, gives satisfactory strength combined with soundness. In effect, eight to ten parts of plasterers' coarse stuff is gauged with one part of cement immediately before use.

COLOUR OF MORTAR

The colour of the mortar aggregate and the width and form of the jointing have an important influence on the finished work, and should always be considered in relation to the bricks used in faced work. Black mortar is an abomination and should be rigorously excluded; white mortar (with its "doll's-house" suggestion) may be nearly as bad, except with white bricks, when an even effect of mass may be desired. Brown and yellow sands are usually preferable, though when any form of pressed-in or raked recess joints is appropriate, a colder tone may be harmless to the effect.

TYPE OF JOINTING

The type of jointing employed can be varied. Artificially roughened bricks such as "Phorpres" rustics, which have harsh arrises, look best if the joints are filled full, and surplus mortar (after each brick is pressed home) is wiped or scraped with the trowel edge to give a wide, flush, rough joint, even slightly lapping the brick arris, as may be seen to full effect in Ruislip Village Hall, by Gordon Jackson. Generally speaking, a wall built and jointed in one operation, with no subsequent raking or pointing, is not only a sounder job, but better in appearance. The so-called "weather-struck" joint is largely fallacious—its convincing section omits consideration of *vertical* joints, which are the chief source of penetration. The ideal practical finish to brickwork is a joint which is homogeneous in substance and equal in texture—either increased density at the face produced by strong pressure with a jointing tool, or (of course) a joint formed by later-pointing with a mortar of different composition, both tend to render the joint liable to be affected by frost.

BOND

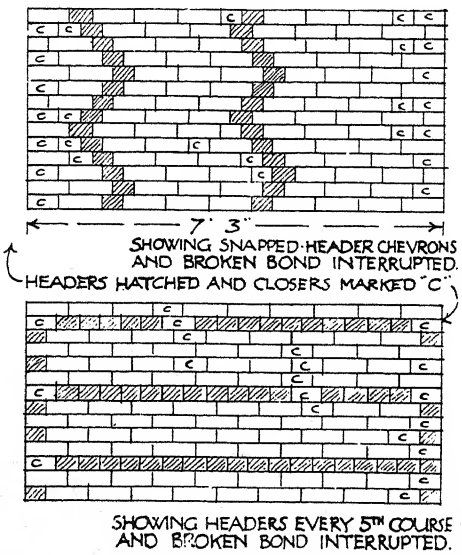
The structural importance of bond in brickwork has been over-emphasised in textbooks—probably from the fact that it is the most easily communicable property, lending itself

most readily to examination questions! If it were as important as alleged, no flint or rubble wall would have much chance of standing. This is not to say that bonding as a principle can be ignored—brickwork in which an easy path for cracking and settlement is afforded will obviously be inferior to that in which any point load is distributed, and the liability to fracture resisted; but since the general adoption of concrete foundations, supersession of wood lintels and bond-timbers, and introduction of cement-gauged mortar, strict bonding as a vital necessity has receded in importance. From the point of view of appearance, however, it might receive fuller consideration. Stretching bond (which follows the nearly inevitable hollow wall), and the customary Flemish and English bonds, are both subject to visual defects which are capable of avoidance.

STRETCHING BOND

In the case of stretching bond, unless every dimension is an exact multiple of a brick length, "broken bond" is bound to occur. Where this arises in the midst of a wide expanse of brickwork it is very conspicuous, giving the effect of a clumsily joined crack. Where walls are to be plastered or colour-washed this is unimportant, but in faced work it should be avoided by changing the point of incidence so as not to run continuously in a vertical direction.

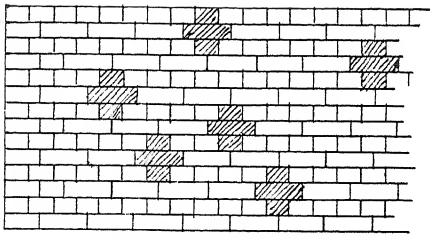
The general effect of stretching bond is also found to be mechanical and regular. In particular, when good facing bricks are used it is apt to be disappointing, mainly because the attractive variations of colour in the bricks are chiefly confined to headers —which do not appear. Such bricks, moreover, are commonly liable to a fair proportion of fractures in handling, results in delivery of numbers of half-bats. By utilising these either as a recurrent feature in each course (Fig. 10), or to form a complete course every fourth, fifth or sixth course in height (Fig. 11), the opportunity is given for the desirable change in "broken bond," and the dullness of the whole effect is relieved by incidental creation of impalpable chevron or striped effects akin to those of early brickwork. It should, however, never be forgotten that diapered or other patterned effects in brickwork are liable to become offensive if contrasts are too great—a mistake often made in works of the Gothic revival, when blue or black bricks were used for dark headers, and (still worse) white bricks for quoins and bands. The natural differences produced by burning are sufficient to produce "impalpable" patterns.



FIGS. 10 & 11

ENGLISH AND FLEMISH BONDS

The more ordinary bonds applicable to solid walling—English and Flemish —gain interest if they are somewhat varied. The variety of English bond in which the vertical joints of the alternate stretching courses break bond in succession (Fig. 12) result in every combination of a stretcher with two headers forming a cross, so that the whole area of walling appears to arrange itself as a not-too-insistent diaper.

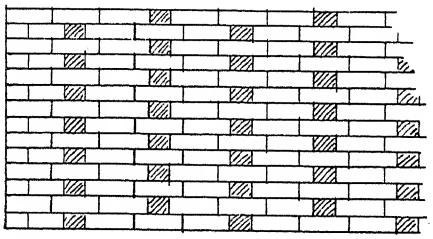


CROSS BOND. ✠-FORMS ONLY
STRETCHING-COURSES BREAK JOINT

FIG. 12

FLEMISH BOND

Flemish bond, in its rigid application, is rather a dull affair, but a bond which has some of the properties of this and of garden-wall bond (Fig. 13) gives a very interesting texture to large expanses of walling.



GARDEN-WALL BOND 3:1
ALTERNATE COURSES REPEAT

FIG. 13

It will, of course, not be forgotten that the cost of expensive facings is greatly reduced as the proportion of headers to stretchers falls, since headers sacrifice half their available face buried in the wall. It is thus less expensive to use face-brick in cavity walling than in any other form. It is also possible, with less complication, to use thin facing and standard backing, since horizontal joints can coincide every foot in height, at which levels the metal wall-ties occur.

BRICK FOOTINGS

Brick footings in offsets are an anachronism where sound concrete foundations are formed—they are a survival of earlier attempts to do what the concrete effectively does: spread the load over an uneven or compressible bottom. It is, however, not desirable to go to the opposite extreme and start 11-in. cavity work straight off the foundation concrete. There are two reasons against this practice, both with a sound practical basis. First, a cavity below ground line may become charged with water; secondly, 11-in. cavity walling (particularly when the work is "green" and not loaded by superstructure) is liable to yield to the effect of filling and ramming such as may occur when spaces within walls are brought up to the level for solid floors. For these reasons it is good practice to build the bases of cavity walling in 14-in. solid work up to ground level, as shown later in Fig. 14.

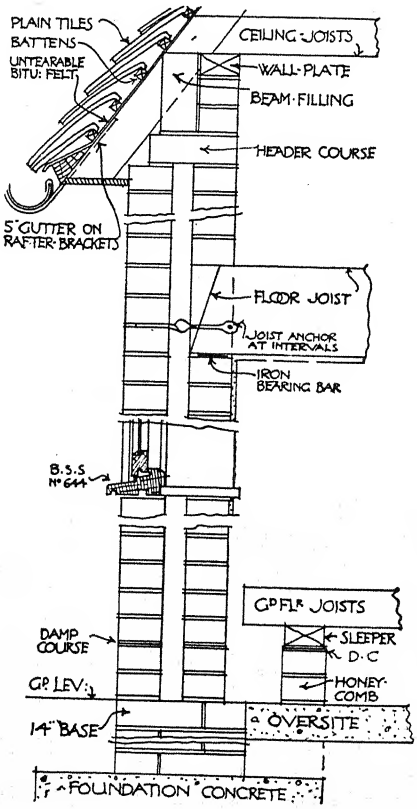


FIG. 14

SLEEPER WALLS

Sleeper walls are customarily built honeycomb, for air circulation below floors. It is sometimes worth consideration whether a more economical practice, when the under-floor space is 3 ft. or more in depth, is not the formation of a number of isolated piers supporting stiffer sleepers, or even the omission of intermediate supports and construction of floors on stout joists or with binders.

CAVITY WALLS

Hollow walls. The pronouncement of B.R.S. that " no case of the penetration of moisture through a properly designed and constructed cavity wall" has ever been brought to their notice, with the declaration that " with the materials at present available, the cavity wall is by far the most satisfactory form of construction for domestic buildings," should have done much to remove doubts which have been entertained by many as to the merits of this form of construction.

WEAK POINTS

Apart from such obvious (and preventable) failures as are liable to be caused by carelessly allowing blobs of mortar to lodge on the metal wall ties, such troubles as have arisen have generally been around openings, and more rarely at the base and head of the cavity. The section shown in Fig. 14 gives a safe detail at each of four vital points (see also Fig. 9), and the

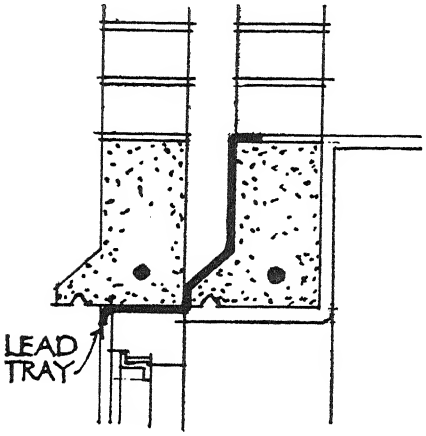


FIG. 9

two plans A and B (Fig. 15) are based on the recommendations of B.R.S. Questions and Answers, 3rd Series, No. 175, which follow practices adopted by many architects with success for some years past. A variant, C, has also been used with success when it has been desired to set window frames nearly flush with external wall face. When bituminous felt is employed as vertical damp-course in this position, it is unrolled as the work rises, and is very conveniently so used. The pressed steel cavity frame shown later in Fig. 135 is another satisfactory method of securing disconnection.

The solid wall-head shown in Fig. 14 stabilises the outer skin of walling by transferring to it some of the weight and thrust of roof construction; apart from some such treatment,

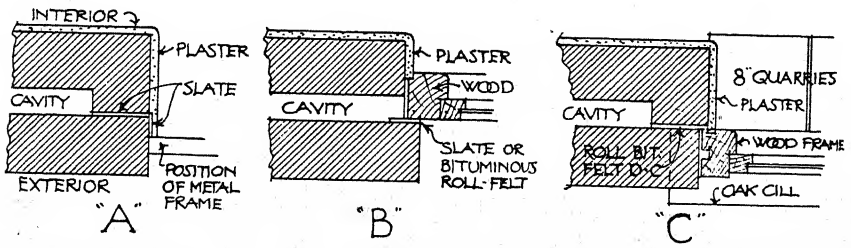


FIG. 15

means of internal openings from the space between oversite concrete and ground-floor joists; and in some cases air inlets have been arranged by 9 in. x 3 in. air-bricks on end in the reveals of doorways; but, generally, in normal situations, the ventilation of the cavity can be left to look after itself. The pros and cons are fully discussed in B.R.S. Questions and Answers, Series 1, No. 14.

FAIRFACE WORK AND POINTING

Certain parts of most houses, where plastering would be liable to damage or be thought unnecessary (e.g., garage, fuel store and tool-shed), may be built "fairface and flush joints." It should be remembered that a 9-in. wall cannot usually be built with a good flush face both sides, owing to variation in length of headers. A wall 4½ in. thick has less chance of irregularity if the bricks used are reasonably true in shape. Sand-lime and concrete bricks, which are not liable to shrink or distort, since they are not fired, give the truest double face.

GROOVED BRICKS FOR PLASTER

As mentioned in passing earlier in this section, bricks lacking in roughness of texture and suction may afford poor adhesion to plaster or rendering, and it is advisable to include at least a proportion of specially grooved bricks to provide a key.

LIMEWHITING

This comes traditionally within the bricklayers' work. A good recipe for weatherproof lime-white is often sought; the following has been found satisfactory in use even in exposed positions. It is given, with a general discussion of the subject of external colour-washing, in B.R.S. Questions and Answers, Series III, No. 130.

"'One bushel of fresh quicklim is placed in a barrel with 20 lb. fresh beef tallow, slaked with hc water and covered with sackclot to keep in steam.' It is ready fo use when cool. Dry colours ma be added if desired. The best wa to introduce the colours into th lime mixes is to add them befor slaking the lime, and then to ru the slaked product through a fin sieve to remove all lumps and un slaked particles."

Colours used should be of the lime fast type, preferably earthy pigments such as the ochres or sienna, and a preliminary trial of colour proportion is desirable, as the whole batch should be prepared at once; otherwise differences may be unpleasantly conspicuous. On rough-cast, stucco, or brickwork of porous, open texture, this mixture can be applied direct (after thinning with clean water to workable consistency), and should prove fairly resistant to weather. On dense, smooth-faced bricks or plastering it may be desirable to prepare by a slurry of Supercement.

PROJECTIONS

In most house designs the occasion arises for projections of some sort, which may be corbels, gable-springers, or simple oversailings such as should occur at chimney caps. The latter are (unpractically) out of fashion, but will be discussed later under "chimneys." The tendency of most workmen, and many designers, is to over-emphasise all such features, and to rely too much on a regular rate of oversail—often 2¼ in., which is coarse.

As an instance, the common gable-springer, which may be formed in many ways, can be simply and practically formed either (1) by building in a concrete slab to line up with soffit and eaves projection—applicable to plastered houses; (2) by forming a visible springer of plain tiles block-bonded—applicable either to brick or

plastered finish, but detestably often accentuated by projection from the gable face, with which it should be flush; (3) in brickwork, which looks equally well whether the building is faced in brick or limewashed. Coarseness should be avoided in the latter case by minimising individual projections, and the happiest effect is, perhaps, gained by prolonging the springer downward and allowing the eaves to show clear behind it. Examples of the three treatments are given in Fig. 19.

RELIEVING ARCHES

With the gradual supersession of wood lintels by concrete, the relieving arches, once invariable, are also falling into disuse. When they are employed it still seems necessary to say that the skewbacks should be thrown clear of the *ends*, and not merely of the bearings, of the lintel they are intended to relieve.

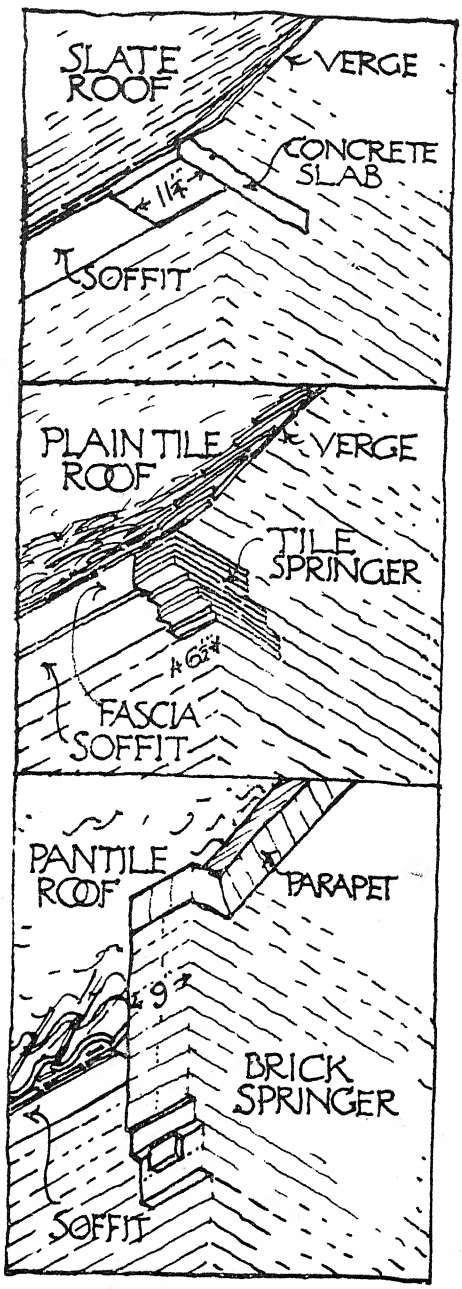
TRIMMER ARCHES

The trimmer arch, which formerly supported the hearth of every upper-floor fireplace, has also been generally supplanted by a flat slab of *in situ* concrete, with direct bearing on wood fillets secured to the trimmed joists. The fillets are sometimes both too slender and inadequately secured. The rough-boarded centering which remains in below the hearth slab may also at times become a source of danger if one of the low-hearth types of fire is used. Hearth concrete should on no account be *breeze* concrete.

DAMP-PROOF COURSES

The relative merits of various accepted materials for damp-proof courses have often been discussed. They may be briefly summarised as under:—

Doubled Slates in Cement.—Impermeable and unyielding; do not squeeze out under pressure, but are liable to fracture or accidental displacement if



GABLE SPRINGERS (GUTTERS NOT SHOWN)

FIG. 19

(as not unusually) the dampcourse remains uncovered for some days after laying.

Mastic Asphalt.—Impermeable and slightly flexible, but not liable to squeeze out under such pressures as the ordinary house can produce. Immune from risk of fracture, and reasonably so from accidental damage as above. Expensive if trifling in extent, owing to cost of transport of asphalter's plant.

Roll Bitumen. — Variable in efficiency; high-grade qualities, particularly those with leadfoil interlayer, highly reliable. Immune from risk of fracture, but some varieties tend to squeeze out in hot weather, and cases have been known where a complete superstructure moved to one side on its dampcourse. Easy of application and not readily damaged after laying, though displacement must be watched for.

Metals. — Sheet lead, copper, etc. The discovery that lead is adversely affected by contact with Portland cement [5] has acted against the employment of sheet lead in dampcourses, unless protected between layers of bituminised material.

Blue Bricks.—In some Midland districts, two courses of blue Staffordshire bricks are the customary provision for a dampcourse. They are impermeable and unyielding, less liable to damage or accidental displacement than most types, and have the advantage that when laying the dampcourse the building is actually being raised 6 in., which tends to counteract otherwise high cost. If all vertical joints are left open and dry, the risk of damp rising by capillarity is minimised (B.R.S. Questions and Answers, Series III, No. 185). A damp-proof course at the base of all walls is now accepted practice. Equally effective courses in parapet and gable walls, in chimney-stacks above roof, and around window openings in cavity walling, are also a necessity.

5 B.R.S. Bulletin, "The Corrosion of Lead in Buildings."

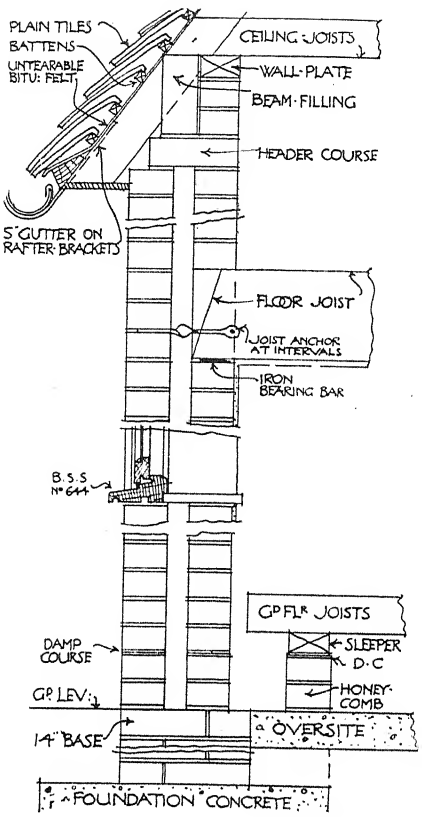


FIG. 14

BEAM FILLING

Less attention seems to be paid to this provision than formerly was the case; it should not be neglected. Filling in with brickwork between the feet of the rafters, as shown in Fig. 14, performs valuable functions as a draught-check (and consequently fire-check) to the roof space, and it has also some value in steadying the structure.

PLUMBING ANGLES

The number of external angles which impede the bricklayers' pins and line and may require plumbing has an important influence on the speed (and cost of a brick structure,

and restriction to four is one of the many reasons why a simple rectangle is the cheapest plan. Builders, however, should be persuaded that the external projection of chimney-breasts on the end walls, which results in an extra foot or so of effective room-width internally at little cost in material as compared with internal breasts, does not necessarily involve two extra angles to be plumbed and an interruption of the bricklayers' lines. By keeping the projection consecutively one course below the main wall, in such a case as Fig. 16, the lines can pass the projection. The external angles of the breast can never be seen against the sky, and with ordinary skilful workmanship need no plumbing.

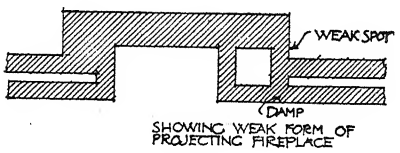


FIG. 16

REVEALS

In most circumstances the formation of external 4½-in. reveals to window frames is a sure way of conferring a hard and mean look upon the small house. In cavity walling a setting as shown in Fig. 15c can be quite successful, but it is advisable not to attempt too fine a joint between the back of the wooden frame and brickwork. Absolute contact cannot be maintained—the frame is certain to shrink—and if any jointing material is necessary a better filling can be attained where there is space to fill. This is also true where metal frames are built in direct; a rough rule in such cases is to leave a space for pointing equal to the thickness of the fingers, which can be filled later by external roughcast (Fig. 20) or plaster without burying hinges, or pointed up if brick facings are provided.

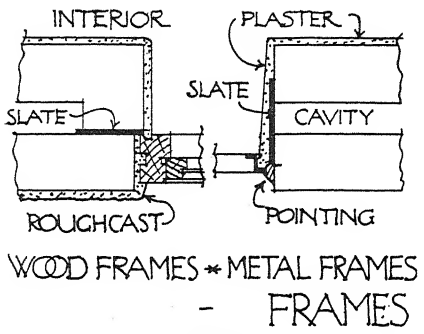


FIG. 20

IRREGULAR ANGLES

Most brickmakers produce "specials" based on an angle of 45 deg. in plan; other angles such as 30 deg. or 60 deg. may require cutting and rubbing. In some makes of brick—e.g., Luton greys—this is unsatisfactory in practice, as the bricks do not cut well and the internal substance differs in colour from the face. In such conditions it is sometimes desirable to use a softer red brick for all quoins and reveals, making capital out of necessity as was done in the effective treatments of the Georgian builders, who used hard brown stocks for straight

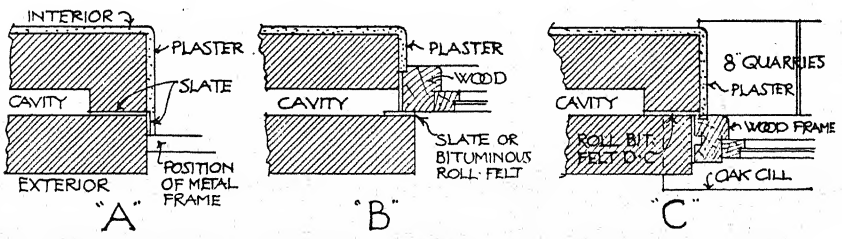


FIG. 15

work and softer reds for all margins where closers would be called for. Another expedient which might be employed more frequently is the "crossed angle," in which courses project right and left alternately, as shown in Fig. 21. This treatment can often be applied to the recessed porches over external doorways, which, if made merely of the width of the door frame, have a pinched effect, but if widened out with splay jambs to some 5 ft. or so give a sense of welcome and some valuable space. With an angle of 120 deg. (that is, sides splayed 60 deg. on plan) a simple crossing of corners produces a tidy, well-bonded quoin without any cutting or rubbing of exposed brick faces.

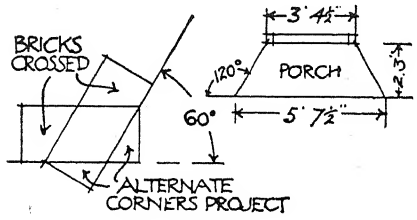


FIG. 21

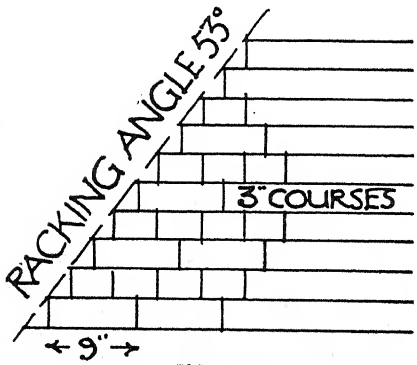


FIG. 22

RAKING CUTTING

Few people seem to have realised that with bricks of standard size there is a rational gable-pitch arising from the racking angle (Fig. 22). From the fact that most old houses will be found to have roofs of this pitch it might be possible to deduce that brick dimensions were settled to suit, but, of course, the reverse may be equally true—probably an interplay of conditions produced roof pitch and brick size. The fact to remember is that a roof pitch between 50 deg. and 53 deg. (according to size of brick and width of joint) makes gable lines follow the "diaper" of the mortar joints and reduces cutting and disturbances of bond.

CHASES FOR PARTITIONS AND PIPES

The increasing use of various forms of thin block partitions, which are not erected (as would be the case with 4½-in. walls) concurrently with brickwork, entails provision for bonding these into the main walls at points of juncture. The provision usually made is by recess either three or four courses high at similar intervals in height, into which pockets successive alternate courses of blocks are pinned in cement during erection.

The growing multiplicity of pipes and conduits in modern work suggests the desirability of some scheming to render these less conspicuous by grouping in special ducts or chases formed in advance wherever possible.

BRICK REINFORCEMENT

By the use of wire-wove or expanded metal reinforcement in the horizontal joints, brickwork spanning openings or weak places may be made substantially self-supporting, and this device might more frequently be employed.

BRICK PAVING AND STEPS

A very convenient and homely manner of forming external steps and the margins of paved areas such as loggias or porches is by a course of brick-on-edge. The angles of such marginal

finishes present some difficulty, as the corner brick stands in some danger of becoming loose or dislodged. If this point, or sometimes the whole of a riser, be formed of a brick-on-end, its lower part buried in concrete, or within the next step beneath, the risk of accidental displacement is greatly reduced.

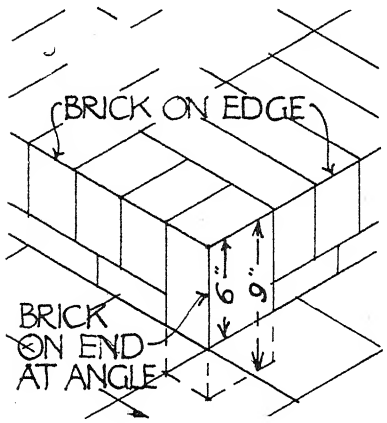


FIG. 23

BRICK FIREPLACES

These are a fancy which people are inclined either to like or detest very much; they can, perhaps, be characterised as somewhat of an affectation, but people *will* have them. Most of those produced commercially are over-designed, and most of those built up by builders from the ordinary bricks used in the same house look coarse and crude. To attain a successful result, bearing in mind that this must be viewed at close quarters, it seems necessary that the bricks used should never be thicker than $2\frac{1}{4}$ in.; that even so one or more tile lacing courses should be introduced to give scale; that the jointing material should *never* be cold grey or strong white cement, but either warm oatmeal-tinted grey or rich yellowish-brown mortar; that hard-lined struck joints should be eschewed and either full flush joints, or recessed raked joints should be formed.

HEARTHS

As before mentioned, the brick trimmer-arch for upper floor fireplaces is almost a thing of the past. Ground-floor fireplaces still retain their fender wall and the hardcore which fills the space within it for support of the hearth. It is curious that custom which followed the necessity of placing wood or coal fires at or near floor level should for so long have caused the placing of gas and electric fires similarly. Gas or electric fires of the panel type can perfectly well dispense with hearth-trimming and consequent complications, if they are raised up the wall sufficiently far to avoid risk of scorching the carpet or floor. Even if a hearth is desired for such types as these, it can overlay the floor within a margin or kerb.

SETTING STOVES

The common modern practice of building fire-openings capable of receiving the largest possible interior-grate, and subsequently inserting one of less size makes it important that care should be exercised to see that the space around the fireback and cheeks is properly filled up, and with suitable materials. If unfilled, it will be a lodging-place for soot, which is inaccessible, and may become ignited and smoulder, while, if the filling is coke breeze or unsuitable clinker concrete, it may also ignite and consume. The heat generated by modern forms of hearth fire is so intense that great care needs to be taken to preserve adjoining work. It is no uncommon thing for the paint-work on a skirting in a room backing on to such a fire to become blistered, or even for the woodwork to be charred by the heat. No fireback so situated should be less than 9 in. thick.

FLUES

While the first idea of every person afflicted with a smoky chimney is to have recourse to some pot or cowl, a good many of the troubles commonly experienced are due to causes which no such addition can hope to cure. Because they affect things which the bricklayer should do, this may be the most convenient point to treat them.

Wherever there is combustion there must be an air supply, which is generally sufficiently (sometimes *too* sufficiently for comfort) drawn by the fire through such crevices as the margins of doors and windows, joints in flooring, and possibly slowly through the actual structure of walls and ceilings. In rooms which have solid floors, well-made metal casements, and closely-fitting doors, it is not uncommon to find "draughts" so efficiently excluded either that combustion becomes sluggish, or the needed air must be drawn down the same flue that is to remove smoke—a condition which causes a general smoky smell, and occasional puffs from the fireplace. Where this condition obtains, a direct air-supply to the fire (possibly in the hearth) is the remedy.[6] The presence of a large cavity between the grate-setting and gathering of flue, as described previously, may be a cause of poor draught—the gathering may best be formed as close above the chimney inlet as possible.

It is an accepted thing in flue construction that a straight flue which permits sight of the sky from the fire-opening is likely to be subject to downdraught, so that any case in which the natural sweep of the flue fails to achieve this must be given a "cripple" or intentional bend. On creating this it is important that the area of the flue should be preserved, or even slightly increased, and to do this a simple rule is to make the courses rise as shown in Fig. 24. Flues which are cold will not draw as well as those which are warm. Damp flues are always colder than dry, which is a reason for planning so that flues are grouped on internal walls and rise from the ridge. It is also a reason for combined stacks rather than individual flues, which have all sides open to saturation by rain. It is a good practice to make all chim-

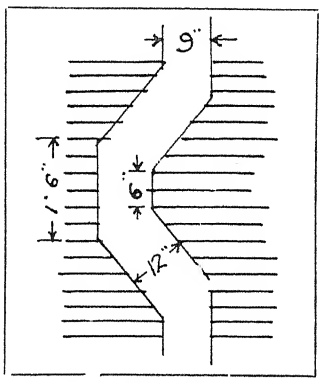


FIG. 24

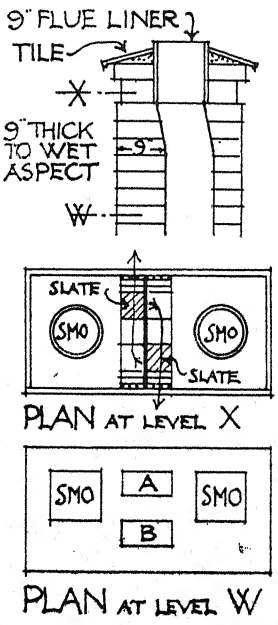


FIG. 25

[6] B.R.S. Questions and Answers, 3rd Series, No. 220.

neys exposed above the roof at least 1 ft. 10½ in. thick, disposing the flues so that 9 in. thickness of brickwork encloses them on the rainy sides—usually south and west. The outlets at top, and pots (if any) should be brought to a central position before emergence (Fig. 25).

HEIGHT OF CHIMNEYS

Insufficient height is a frequent cause of chimney failure. Chimneys rising from or near the ridge should extend *at least* 3 ft. above the ridge; chimneys near the eaves should rise to a height overtopping the ridge rather more than that, unless some special measures are taken to prevent downdraught from swirling currents when they are on the lee side.

PARGING

The parging and coring of flues might receive more attention than it usually does; it is not infrequently that parging is found flaking off in large sections after a few years, having had little adhesion and rough treatment by sweeps' rods, while as to coring, if this were always done it would be difficult to explain the brickbats and pieces of tile which have, within the writer's knowledge, been found lodging on bends and obstructing smoke.

A special problem arises in the case of continuous-burning coke boilers.

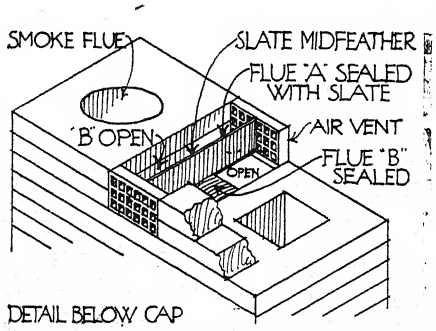


FIG. 26

Not only the parging, but the actual structure of the flues of such now customary appliances are often found badly disintegrated. This appears to be due to sulphurous gases in the boiler fumes, in conjunction with moist conditions. It seems advisable that such flues should be lined with impervious acid-resisting flue liners.[7]

GAS FLUES

The increasing prevalence of gas fires in bedrooms and occasional rooms in houses receives attention in the latest edition of the Model Bye-laws issued for local authorities by the Ministry of Health, which prescribe " an adequate flue " which must discharge either to the external air " with a suitable terminal or outside windguard," or to uninhabited roof space if this is adequately ventilated. There are two points in which gas flues may materially differ from smoke flues—since they are not liable to gradual obstruction by soot they may be less in area; and since they will contain a good deal of water vapour which has little drying power it is advisable that they should have covered tops to exclude rainfall. The appropriate area of each flue, for perfect and economical gas consumption, will depend on the type of fire, but generally, in domestic use, an area between 30 and 40 square inches is ample, which permits two 9 in. by 4½ in. flues to be formed back to back in a 1 ft. 10½ in. stack. Measures must be taken as shown to prevent blow-back of fumes from an active fire down the adjacent flue of one not in use (Fig. 26). Where thin partitions are involved, flue blocks of the " Nautilus " type may be conveniently employed, and it should be more generally known that in the range of fittings there is included an inconspicuous ridge terminal which is less

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7 B.R.S. Questions and Answers, 2nd Series, No. 119.

" casual " in appearance than the ordinary flue top poking up through a roof slope.

ANTI-DOWNDRAUGHT SPECIFICS

Apart from the ordinary practices detailed above and from measures which may be taken at the chimney-top, which will be described later, there are things which can be done to counter a tendency to downdraught, though their certainty and the manner in which they work remains obscure. One such is the " draught table " (Fig. 27), which seems to act as a baffle to sudden downward eddies, but has the disadvantage that it collects fine powdery soot, which is apt to sift off the ledge and descend into the grate and room when no fire is alight to create its updraught. See also Fig. 151 and the further discussion of this relating matter.

Land-drains set at an angle in the flue brickwork clear of the roof and some distance below the chimney-cap are also often seen, but are rather a counsel of despair. No principle seems discoverable to guide their placing.

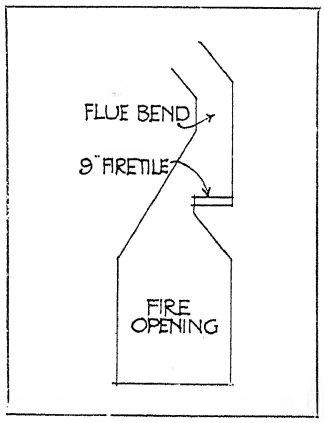

FIG. 27

CHIMNEY SHAFTS AND STACKS

Some of the more desirable characteristics of chimneys have been mentioned in discussing flue building—e.g., the least thickness of 1 ft. 10½ in. weakness of single flues, superiority of ridge position. Two further points which are not always realised are the folly of plastering, rough-casting or whitening stacks which rise from and are surrounded by roof slopes in which they appear as islands; and the good sense of providing every chimney with some sort of projecting cap which will assist to keep the structure dry and prevent streaks of sooty water from running down the sides. The capless " chopped-off " stack may have a temporary vogue, and no doubt looks very smart on a drawing, but very shabby after a few years' exposure.

The chimney-pot is in essence a cheap expedient for giving extra height and a neat finish to flues. It is not specially beautiful, though some of the old hand-made types, delicately tapered and embellished with glazed running patterns below the nicely moulded rim, constitute a possible exception. Where a pot is omitted, a sound finish is made by bedding a 9-in. flue liner in the head of each flue, standing clear from the flaunching about 1½ in. to 2 in. (sufficient to check rainwater from running down the flue). If the weathered flaunching is covered with slate or tile, according to the material of the roof, it not only looks better, but is a sounder, more enduring job (Fig. 25).

COVERED CHIMNEY TOPS

In specially wet and windy districts covered chimney tops are commonly adopted. In a deluge, the amount of rain which can descend an open chimney top makes this desirable. Methods of covering differ from district to district, and it seems reasonable to follow local practice, where this exists. A collection of examples is given in Fig. 28.

It should be borne in mind that oversailing and similar projections in

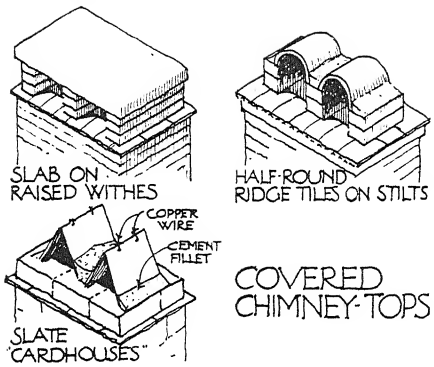

FIG. 28

chimney caps are seen in profile on the mitre at corners, and are much intensified thereby. Generally, $\frac{3}{4}$ in. is sufficient for any single oversail, or $1\frac{1}{4}$ in. at most. Two and a quarter inches is common, but gives a coarse effect.

FIXING METAL WINDOWS

One important point in this connection has been mentioned under " reveals "; this relates particularly to metal windows which are built in directly to brickwork, but this practice is one open to several objections, and in domestic work of ordinary economical character there are several advantages (not at first glance obvious) attaching to the use of wood " surrounds " to metal frames. A " surround " seems now to be the established term for a wood frame which is marginal only, as differentiated from a " frame " which embraces mullions—and possibly transomes—as well as jambs, head and cill.

The advantages of a wood surround for building in are, briefly:

(1) With standard cottage and similar light forms of casement it protects the window during transport, and prevents distortion, which is otherwise not uncommonly suffered.

(2) It affords more substance to retain jointing material around the setting, and also has a less mean appearance when fixed.

(3) It entirely prevents hinges becoming buried in plaster or roughcast.

(4) It permits individual windows to be easily exchanged either for different types, or in case of damage after fixing—a matter of some difficulty with built-in iron frames having lugs.

(5) The joint metal-and-wood margin seems to fulfil something of the compensating action of a chronometer—the steel expands and the timber shrinks in hot weather; in winter the reverse process occurs.

For all of the above reasons, therefore, the wood surround seems advisable. Surrounds, and in fact all wood frames, are commonly delivered with " horns " on the head and cill. Builders often fix them as received; for good effect and secure fixing, the heads should be cut off to a 60° splay on plan, running from a line in continuation of the back of frame in front.

SLAB AND BLOCK PARTITIONS

These very modern building components form the subject of B.S.S. No. 492, and it seems highly desirable that its provisions should be generally observed in view of the numerous cases of trouble which have arisen with so-called " breeze slabs " composed of various inferior forms of clinker containing unburnt coal and refuse.[8] The chief troubles likely to arise with inferior materials and unsound methods of manufacture are expansion and contraction (which may distort the partition or throw off wall-tiling); efflorescence damaging to plaster or decoration; and rapid decay of metalwork buried or in contact.

An alternative to clinker, pumice, or breeze slabs is the hollow block or slab of burnt clay or Moler earth.

8 B.R.S. Bulletin No. 5. " Properties of Breeze and Clinker Aggregates."

These are slightly more costly than clinker slabs, but less subject to develop troubles after fixing, the only drawback being occasional difficulty in chasing conduits not provided for originally. Blocks and slabs which will hold nails are more convenient in use, and this point should be ascertained when making choice.

Other types of partition slab, notably plaster and mineralised wood-wool, will be dealt with under " Plasterer," as these are usually erected by this craftsman.

DOORHEAD CRACKS

A defect which is all too common (in fact, nearly invariable) in thin slab partition work is the appearance of vertical cracks above any door jambs, running from the door head to ceiling level. These are due, of course, to shock and vibration produced by the slamming of the door, acting on slender frames or linings and fracturing the slabwork and plaster at its weakest point. The apparently obvious precaution often taken is to prolong the jambs of frame or lining past the head up as far as the ceiling, with a firm fixing to the ceiling or floor joists above, but this is usually ineffective, since, from its narrow depth, the frame will still vibrate, and the plaster which covers it readily cracks—helped, probably, by inevitable shrinkage of the timber horns beneath. Metal lathing over the portion of partition above the door head, and extending for about a foot on either side, may check this tendency, but the only sure preventive is to make frame and architrave extend to the ceiling, with a transome above the door, filling in the " fanlight " so formed with plywood or wallboard (doubled if desired), or with glass if it seems beneficial (Fig. 29). There is no visible cracking by this method, for obvious reasons, and the flexibility of choice which it permits as to glazed or solid filling is often

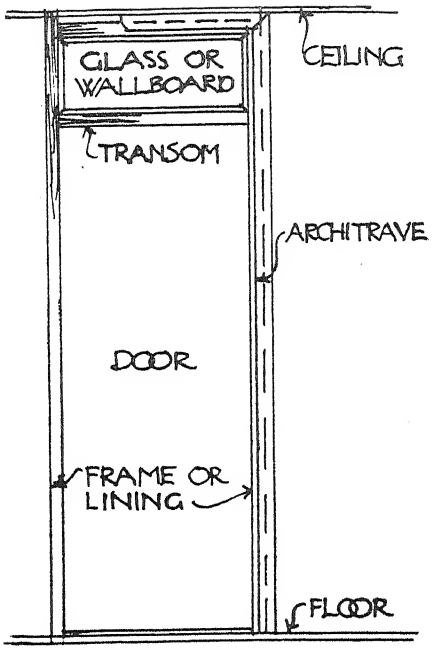

FIG. 29

useful. The support afforded to thin slab partitions is often inadequate, encouraging vibration and the easy passage of sound. When standing upon timber floors there is always liability to a settlement of about $\frac{1}{4}$ in. as joists and boarding shrink, and as the process happens usually after buildings are plastered, decorated and occupied, the appearance of a horizontal crack near the ceiling is most unwelcome. This defect must, however, be accepted and rectified later, when the method is necessary for reasons of simplicity or cost.

QUARRY PAVING

" Bricklayer " specifications usually end with a series of omnibus clauses dealing with the many minor operations which the bricklayer performs. One of the chief of these is the formation of quarry-tile cills and laying of tile floors.

Workmen left to their own devices will usually lay quarry paving " bonded "; it looks much better

arranged checker-fashion, but there is reason in the preference shown by the layer for the bonded arrangement if close jointing is desired, since, like all fired clay products, there is a certain amount of irregularity in the tiles, which is more easily disguised if the joint-lines are interrupted. Paving, however, looks much better when joints of $\frac{1}{4}$ in. wide or upwards appear, and by this means the slight inequality in size and shape of quarries is effectively obscured, though admittedly it requires a much higher degree of skill to lay and finish a floor checker pattern with well-filled wide joints. In most situations it is possible (and preferable) so to adjust joint thickness as to secure the use of an exact number of full tiles; e.g., if the width is 10 ft., 19 6-in. quarries equal 9 ft. 6 in., 20 joints each three-tenths of an inch absorb the difference.

When laying quarry or other tile internal cills, which popularly take the place of the once-invariable window-board, it is even more desirable to accommodate the jointing so as to include an exact number of full tiles. It may be apposite here to mention the reasons which have apparently led to the preference so often shown for a tiled ledge in place of wood. A window-board is subject to severe stress from sunlight and occasional moisture (rain, condensation from glass, or spilled water from flower-bowls), and is nearly invariably found in worse condition either of paint, stain, or surface than the remainder of similarly treated joinery; tiled cills do not suffer similar damage.

SETTING SINKS

This job devolves on the bricklayer. Where space is valuable, it is both simple and convenient to gain $6\frac{3}{4}$ in. by recessing the sink against the outer $4\frac{1}{2}$ in. of cavity walling beneath a window back. Not only does this gain space, but it affords the sink more adequate support. (Fig. 30.) The wall behind sink and draining-boards is now almost invariably tiled, so that no evil consequences to plaster or paint need be feared from the cessation of cavity between sink and window-cill; in any case, the surroundings of a sink are not usually free from moisture.

COPINGS

The one-time invariable brick-on-edge coping with tile creasing is not often seen nowadays; there seems an optimistic belief current that copings are unnecessary, and parapet and gable walls are commonly trimmed flush—possibly with a line of brick on edge. There is, however, virtue in the older practice, as the soaked parapets and streaky wall-faces which accompany the newer one frequently testify.

A coping should fill two functions; it should prevent rain which falls on the parapet from soaking directly

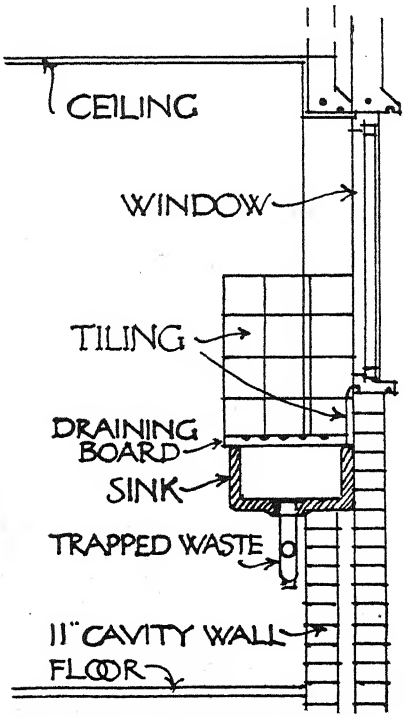

FIG. 30

down, and it should cause it to drop off rather than stream over the wall face, carrying with it the soot and dirt which has lodged above. Tile creasings often fail to achieve one or both of these ends; the tiles may be absorbent, and they may lack any incentive to cause water to drip from their edges. A sound job can be made by the use of plain tiles having the continuous nib which is a turned-down head, or by using ordinary nibbed tiles with the nibs out; water seizes

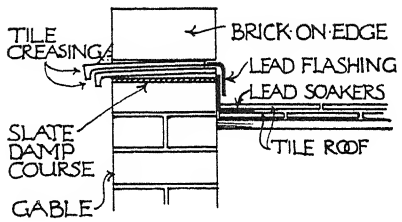

FIG. 31

the opportunity of dripping from a point. As a safeguard beneath the creasing, a slate-in-cement damp course is advisable in exposed situations. The consequences of saturation of parapets are so often a matter of serious trouble to rooms beneath that precautions should not be neglected. B.R.S. Questions and Answers, 3rd Series, No. 162 (Fig. 31).

SOOT-DOORS

Those modern forms of stoves and boilers which are connected to brick chimneys by iron or asbestos-cement pipe flues, require the insertion of soot doors by which sweeping can be done. It is a convenience if these can be so placed that the sweeping (which is infrequent) can be done from outside; but with this arrangement it is more than usually necessary that the soot door should be air-tight. Builders are singularly careless in this matter, having apparently failed to realise that the admission of cold air to the flue by any other course than through the regulated inlets to the fire-grate can ruin the performance of the stove. A well-fitting door with provision for tight closing and an inner "lid" are essentials.

ARCHES

The concrete lintel has practically displaced the arch as a means of spanning openings in domestic architecture, but occasionally emphasis is given to an entrance by constructing it in arched form. This feature needs using with caution if scale is to be preserved. The desirability of widening the entrance to confer an appearance of welcome has already been mentioned (see Fig. 21). This widened opening, however, entails an arch of increased span and rise, which often has a disturbing effect by being sprung needlessly high. Anything over 4 ft. 6 in. will be found sufficient as the height of

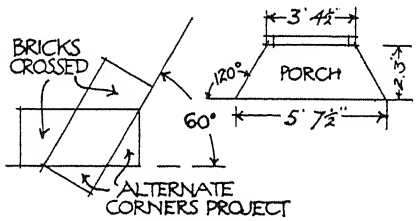

FIG. 21

springing for a semi-arch over 5 ft. in span, because the steep rise next the springing allows sufficient headroom and gives clear 7 ft. in the centre. If the arch is formed in 4½-in. rings, built in "recessed orders" somewhat after the fashion of mediæval times, with setbacks between ¾ in. and 2¼ in. between rings, it is more in scale with a brick-faced building than would be any form of flush arch. In a plastered or roughcast finish an arch appears unnatural. An alternative which is simple in con-

struction and less bald in appearance than a wide-span lintel is the corbelled lintel as shown in Fig. 32. The depth and pitch of the corbelling can be adjusted so as to bring the flat soffit

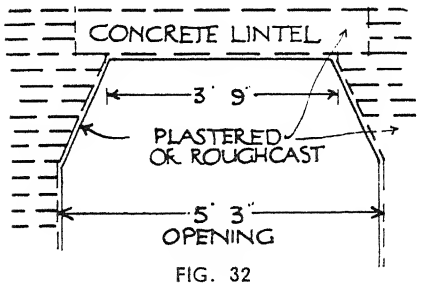

FIG. 32

of the lintel into scale with relative openings.

Gauged and rubbed arches are now little used, except in " period " work. If used they should be married to surrounding brickwork by reveals of similar texture and colour to the arches, as customary in Georgian days —isolated they look awful.

RAT-TRAP OR BOX-BOND

This form of walling, which may be briefly described as Flemish-bond with all bricks laid on edge, is well recognised in Sussex and adjoining counties where tile-hung walls are common, but it is strange to the bricklayer in many districts. When built 9 in. thick, with stretchers separated by a 3-in. internal space, it forms a semi-hollow wall, economises one-third of the necessary bricks, and sets a suitable gauge for weather-tiling. The attempt is sometimes made to nail tiles into the joints, which are formed of ash mortar for that purpose, but nails driven thus are apt to be over-driven so that tiles are fractured; on the whole, it seems better to build with breeze bricks for headers and to nail battens thereto to receive the tiling.

A point of some difficulty arises where rat-trap bond for tile-hanging surmounts a lower storey of 11-in. cavity work and there are breaks or return walls which are continuous on their inner face with partition walls. Normally the box-bond will face up externally to the wall below, giving an extra 2 in. to the upper rooms, but in situations such as appear in Fig. 33, either the return must be 11 in. thick, or a break internally must be accepted.

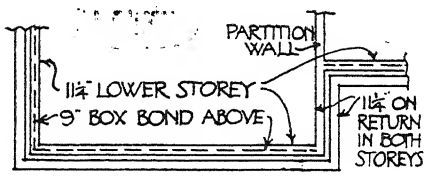

FIG. 33

APPROXIMATE PROPORTIONATE COSTS OF VARIOUS TYPES OF WALLING, INCLUDING INTERNAL AND EXTERNAL FINISH.

	Per yard super s.	d.
9-in. brickwork in Flettons flush-jointed, slurried and distempered externally and plastered inside	15	0
11¼-in. cavity walling faced in rustic Flettons flush-jointed as laid and plastered inside	18	0
11¼-in. cavity walling, joints raked as built and two-coat fine-cast in cement externally and plastered inside	19	0
11¼-in. cavity walling faced in flush-jointed red brick at 120s. per M and plastered inside (each extra 10s. per M on facing bricks increases price per yard by 6d.)	23	6
9-in. box-bond battened and tile-hung, 4½ in. gauge, and plastered inside	21	0

Wood window frames which occur in walls intended to be tile-hung should be projected 2 in. externally to stop the tiling. They may be secured by building in heads and cills, but should have additional fixing by hoop iron cramps nailed or screwed to the backs of the frames and cranked into the upright joints of the jambs. It is necessary to form solid jambs to these semi-hollow walls, but since protection is given by the weather-tiling, dampness should not penetrate.

OPEN JOINTED LAND DRAINS

Many types of land cannot be hoped to provide healthy sites unless provision is made for draining the subsoil, and even where no general system of drainage is provided it may be advisable to run a line of land drains, with provision for outlet, around any building; e.g., in the case of sloping sites.

It is also worthy of remark that most land of a clayey or loamy character which has been cultivated has at some stage of its use been systematically drained, and that development for building by the formation of roads and sewers results in the interruption of the system by cutting of important drain-lines. This commonly leads to puzzling accumulations and outbreaks of water, for which the only cure is the discovery of the interrupted drain and provision of an outlet. The purpose of a land drain should be remembered. Other drains receive liquid at definite inlets and convey it to some safe point of discharge; they must be watertight and free-flowing. Land drains, on the other hand, are designed to leak inwards continuously so as to admit water which otherwise would saturate the soil and convey it to some point where it can discharge—which may be by leakage outwards to a porous stratum, or otherwise. One of the aims of laying land drains, therefore, is the prevention of choking by soil sediment, roots, or silt. With this object it is usual to surround them with a layer of clinker or hard core, and it is not bad practice to cover this filling with a line of reversed turves before earthing over.

Land drains are usually socketless clay pipes, but in recent years a competing type is available which is composed of porous concrete pipes which claim the advantage of admitting soil water freely, apart from their open joints, and having less likelihood of blockage by silt.

STONEWARE DRAIN PIPES

The normal house drains are laid with salt-glazed stoneware socketted pipes, and drain fittings (gulleys, bends, etc.) of similar material. These form the subject of B.S.S. Nos. 65, 540 and 539, which should be incorporated by reference in any building specification.

As well as the plain socket and spigot jointed pipes, there are also available several forms of patent joint, devised either to render easier and safer the laying of drains in water-logged ground, or the preservation of a true invert at the bottom of a pipe-line, which there is a tendency under ordinary conditions to miss. The two most familiar types of special joint are those which incorporate a bituminous collar on the spigot (fulfilling both functions), and those which secure true alignment by a tapered spigot and inner shoulder within the socket, which must necessarily allow an annular space for jointing material.

In those districts which provide separate soil and surface water sewers it is a usual economy to employ second quality (black banded) pipes for the surface water drains, and in those areas where it is permissible to connect rain-water to the soil drains, it is often possible to arrange so that this is allowable by interposing an intercepting trap between the rain-

ater main and the manhole on the il drain to which it discharges. This ractice has the further advantage of reventing rain-water gulleys from cting as discharge points for drain-ir during drought periods, when ey are apt to become unsealed by vaporation; the deeper intercepting ap is less likely to become dry.

OTHER DRAIN MATERIALS

Iron Drains. In some districts holly, and in most where it is necessary for drain lines to pass through r beneath buildings, it is obligatory o form them of cast-iron spigot and ocket pipes jointed in molten lead. hese also form the subject of a .S.S., No. 437.

Cement Concrete and Asbestos-ement. Pipes manufactured from ese materials are also available for rainage, and are covered by B.S.S. os. 556 and 486.

PLANNING DRAINS

Excavating Trenches for Drain ipes. It is now general practice to lan all drains in straight runs from anhole to manhole at distances not xceeding 100 ft. (the length of a set f drain rods), and at the recognised radients according to size of pipe. hese gradients, for drains conveying olids, are determined with the object f avoiding deposits either from too uggish or too rapid flow. Two facts re often overlooked in practice: (1) collection of branch drains entering ne course of a main drain which by s fall has attained considerable epth may with greater economy and fficiency be connected to a shallow anhole, with a single drain plung-ng to the deeper manhole on the main rain (Fig. 35); (2) rain-water drains, onveying no solids, can be laid to inimum falls, either plunging down o enter the manhole on the main rain, or even discharging through the back or sides of the manhole at some point above the benching. Both of these practices effect considerable savings in excavation.

Connections to Public Sewer. In many districts it is the commendable practice for the actual work of connection between the house interceptor

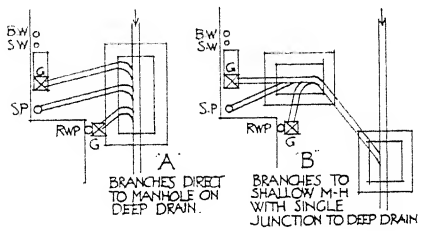

FIG. 35

and the public sewer to be done by workmen of the Local Authority—at the expense of the building owner. It should not be necessary to say that where outlet to an existing sewer or drain is intended, work should start from this point, but cases *have* occurred where the reverse process has been followed with unfortunate results.

DRAIN FITTINGS

The fittings in connection with the normal house drain are rain-water gulleys; bath, lavatory and sink-waste gulleys; intercepting traps; and fresh-air inlets.

Rain-water Gulleys fitted with a back or side inlet by which the down-pipe discharges beneath the gulley grating, instead of over it by means of a shoe are vastly to be preferred. The grating can become blocked by leaves without affecting the flow, so that flooding is prevented.

Bath and other domestic waste-water gulleys on similar principles are even more satisfactory in action, as compared with the common and messy

alternative of open pipes discharging within a kerbed chute or channel. The type known as Sykes Slipper Gulley (Albion Clay Co.) (Fig. 36) has many advantages. Combinations of knuckle bend sockets to receive any arrangements of pipes can be had. The cross section of the grated channel renders it self-cleansing, whatever the flow. Flooding is virtually impossible; the design allows the channel to be set close to and parallel with the wall whatever the direction of the branch. A kerb is unnecessary, and the surfaces in contact with the drain-effluent are entirely glazed stoneware or galvanised iron.

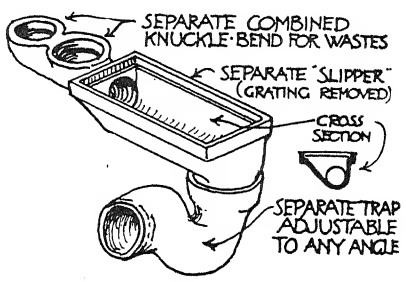

FIG. 36

Intercepting Traps have been discontinued in some districts, and from several points of view with advantage —they are the most frequent point of accidental stoppage, and their utility, when drains and sewers are alike in perfect order, is doubtful. Where they are installed, a type having a quick drop in and an easy outgo is to be preferred as a means of ensuring the passage of solids by impetus through the trap.

Fresh Air Inlets. It is probably no exaggeration to say that nine out of ten fresh air inlets of the slender type commonly fitted are found damaged and ineffective soon afte fixing. They continue to admit air t the drain, but the flap valve intende to prevent the reverse process ha ceased to function and the absurdl light grating which should protect i has ceased to be!

INSPECTION CHAMBERS AND MANHOLES

The brickwork of a manhole re quires a good concrete slab bottom but does *not* require the stepped foot ings so often provided which need lessly increase the amount of excava tion without conferring any benefit

In the internal formation of the bottom, a continuous channel invert with side branches in the form of Barron's bends (three-quarter round) setting on the channel will yield a cleaner result than channels which intersect with the main channel. The concrete benching between the branches should, however, rise steeply from the channel and curve over from about 6 in. so as to form a top surface on which a workman can stand. This shape prevents the easy deposit of solids on the benchings.

Internal rendering, trowelled smooth, should be continuous from channel-fitting, over the benching, and up the manhole sides as far as the cover.

Cast-iron manhole covers and frames of the ordinary light patterns are covered by B.S.S. 497. There is a constant tendency among builders to set these too high, when they become not only unduly prominent, but even dangerous obstacles. Where any form of slab paving is intended, there seems no reason against setting manhole covers at such a level that they may be covered by a slab, which can be inscribed with a number, or other distinguishing sign.

ASPHALTER

GENERAL

Asphalt, which is increasingly used in building work for dampcourses, "tanked" basements, paving and roof-covering, comes principally on the last-named account into the construction of the average house. The various materials have recently (and none too soon) been defined by B.S.S. Nos. 594-597, but the manipulative processes of application are dependent on skill and experience, so that the employment of reliable firms is all-important. Generally, it may be said that the use of mastic asphalt in small quantities is disproportionately costly, owing to such factors as transport of plant and travelling expenses (which spread over a large quantity would be negligible) being the same for the trifling area.

This argument does not apply to the other commonly used form of bituminous roofing, consisting of several layers of bituminous felt cemented by bitumen compound, and it is to the latter that the builder of the small house will generally look for flat roof coverings. This is not the place to argue the relative merits and demerits of pitched or flat roofs, but it is worthy of note that flat-roofing materials appear in the 1937 Model Bye-laws, which (after stating generally that "the roof of a building shall be weatherproof") list among admissible materials:—

"(*d*) Asphalt mastic (containing not less than 83 per cent. of mineral matter) not less than $\frac{3}{4}$ in. thick laid on boards of a finished thickness not less than 1 in. or on a base of concrete or hollow tiles.

"(*e*) Built-up material of a total thickness of not less than 3/10ths in. composed of not less than three layers of bituminous felt laid in bituminous mastic on a base of concrete or hollow tiles.

"(*g*) Bituminous material laid on a base of boards, concrete, or hollow blocks, and covered with a continuous layer not less than 1 in. thick of cement mortar or cement concrete, or with tiles made of clay, concrete or asbestos cement, or with not less than 1 in. thickness of bitumen macadam composed of fine gravel or stone chippings, with no greater percentage of bitumen than 7 per cent."

INSULATION OF FLAT ROOFS

Any habitable room which is covered by an asphalt or bituminous roof requires provision for insulation from extremes of heat, and will be the better for provision against cold from rapid heat-loss in winter. It is no doubt tempting to aim at the achievement of both purposes by a single specific, and to some extent this is possible by the interposition of an insulative wall-board and/or sufficient air-space between ceiling and roof-covering. But for the protection of the covering itself from deterioration by sunlight, the first purpose is better achieved by an upper reflecting and insulating layer such as clause (*g*) above permits, and when it is intended that the flat roof shall serve as a terrace, or otherwise be open to traffic, the provision of the tiled or macadamised layer is almost a necessity. All makers of built-up roofing seem now to have recognised this requirement, and meet it by one or other form of tile surfacing.

RAINWATER DISPOSAL FROM FLAT ROOFS

The margins and outlets from flat roofs always require most careful treatment. It is often forgotten that heavy rainfall does not shoot off such roofs in the way that a pitched roof makes easy. When, as commonly, a parapet is formed, water is held up so that if outlets are insufficient in frequency, area, or access, and are likely to become blocked, it may find undesirable means of escape. The falls of a flat intended to be used cannot be as much as easy scouring by rainfall would dictate, and the surface will require cleaning at intervals if litter and débris are not to accumulate and form a source of danger. Surface channels and cesspits which might define the flow of water would produce complications, and are usually omitted, but the formation of a definite drop against each outlet can be a help to rapid clearance of the flow of water, and should serve to guard against flooding by all but the most torrential downpours (Fig. 38).

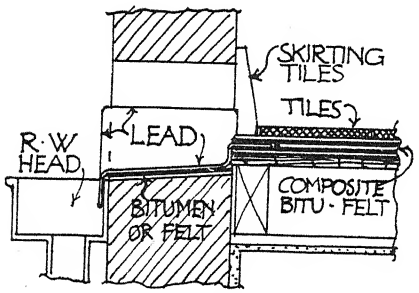

FIG. 38

The tiled surface of a terrace flat should be finished against parapet and other walls by a tiled skirting, usually of splay form; and where construction is of brick, a metal (preferably copper) flashing should cover it.

Where concrete is employed the formation of a horizontal recess or chase to receive the skirting appears to work satisfactorily if the joint is well filled with bituminous compound and pointed in cement (Fig. 39).

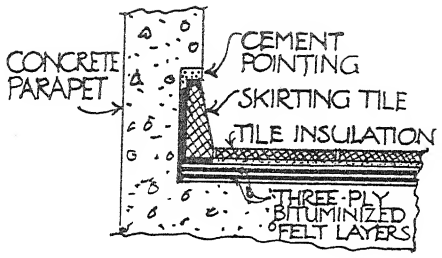

FIG. 39

As well as its employment for wholly flat roofing, asphalt and bituminous sheeting form useful materials in combination with tiles or slates under such common circumstances as the square-planned house produces. It is too painfully evident that this most economical form of plan tends to produce a pitched roof having the form of a pyramid, which (according to the size of the house) may rise to inconvenient and wasteful height.

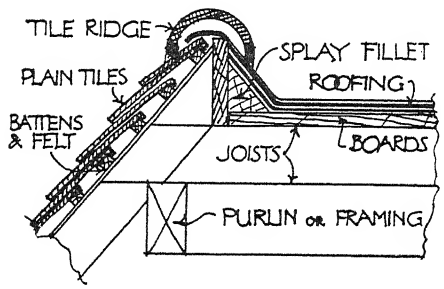

FIG. 40

By truncating the pyramid at a height which gives a reasonable proportion to the roof-slopes, and covering the central area with an asphalt or composite flat, not only is appearance vastly improved but economy may result. The construction is simplicity itself, the only points of difficulty being the finish against the ridge and formation of outlets for rainwater. As to the former, the method shown in Fig. 40 is sightly,

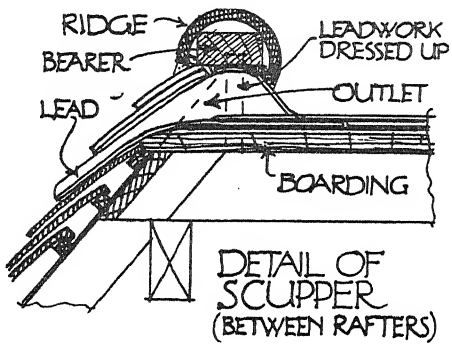

FIG. 41

simple, and has been found successful. Outlets may take the form of "scuppers" beneath the tile ridge (which should continue uninterrupted) and are formed by dressing lead between the layers of asphalt or sheeting and down over the tiles (Fig. 41). These openings should be formed in the least conspicuous positions, and so that water which flows from them will be directed to rainpipes directly below the slopes on which they discharge. The direction of the timbering which forms the flat should be considered with this aim in view.

PAVIOR

GENERAL

The variety of surface material available for internal pavings is now very extensive, embracing many materials in combination with Portland cement (granolithic, terrazzo, and cast stone), various forms of "jointless" flooring of the magnesium oxychloride class, cork, asbestos, and wood-meal compounds, coloured asphalt either *in situ* or in compressed tiles, as well as the more traditional stone, marble or slate slabs, tiles and bricks. The quantity of any particular paving required in a small house is never large, and if cost is an important consideration it should never be forgotten that when specialist forms are introduced, the price is necessarily higher in proportion as the area becomes less, as well as the hindrance to other work while awaiting arrival of men. It is therefore advisable to restrict the *variety* of paving as much as practical considerations allow.

For satisfactory results, specialist materials should be laid by the firms who produce them, and remarks as to procedure are therefore superfluous, but a few detail points as to relationship to adjoining work may be worth mention.

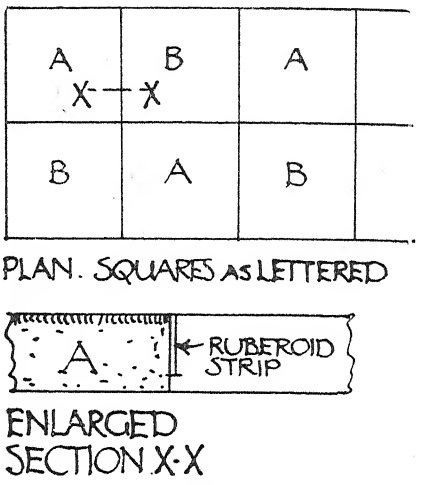

FIG. 7

IN SITU PAVINGS

Granolithic and similar pavings have already been discussed, and in Fig. 7 there is given a sketch of recommended procedure.

Terrazzo does not commonly enter into small house construction, and when it does is usually in small enough areas to render needless the customary provision for panel joints general as a precaution in bigger work. Should these be necessary, strips of vulcanite or metal may be used in the same manner as the bituminous strips in granolithic.

Jointless Floors are now often employed in bathrooms, W.C.s, cloakrooms and the like, and if well laid and properly maintained they give good service. They have the advantage of rendering possible the elimination of the joint at floor level between floor and wall covering, and

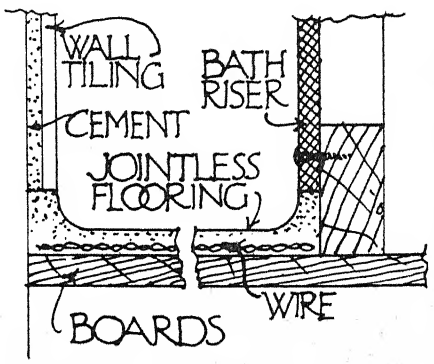

FIG. 42

can be made to turn up with a small-radius cove finishing flush with wall-tiling (Fig. 42). A similar treatment below the riser of the modern type of enclosed bath presents no difficulties, but must be provided for by reduced height of riser panel or by raising the bath feet by adjustment or on pads. The bottom member of the wood backing to which the riser panel is secured serves to stop the cove (Fig. 42). When laid on a wood-joisted upper floor, several methods are practicable:—(1) Boards of a lesser thickness can be used so that the floor surface finishes level with adjoining wood floors.

(2) The flooring can overlie the boarding, stopping against a hard-wood threshold in the doorway.

(3) The cove can continue across the doorway so as to confine any spilt water within the apartment.

It is advisable, when the material is laid on boards, to staple down ordinary galvanised wire netting over the area to be covered so that it is incorporated in the underlayer of plastic floor-material. This is less for the purpose of strengthening the floor than for prevention of cracking due to shrinkage, curling or other movement of the wood floor.

BRICK AND TILE PAVINGS

Brick Pavings have been mentioned in " Bricklayer " and little more can be said.

Tile Pavings have also been mentioned, as regards spacing and scheme. It may further be added that as tile floors inevitably require fairly frequent washing, a wood skirting or painted wall face soon suffers damage, and tile skirtings seem essential. These can most readily be formed by a row of plain or round-edged quarries set on end, but the most satisfactory form is by use of special skirting-tiles as shown in Fig. 43, which (with appropriate angle-fittings) are produced by several makers.

MARBLE AND SLATE PAVINGS

Marble and Slate Pavings will seldom be introduced in the small house, though sawn Cornish slate makes a hall floor which is clean, enduring and possessing character. A variant to customary surfaces for external porches, paths and loggia floors is the checker pattern paving formed of small slates set on edge in cement, which is frequently seen in Cornish churches. It is the most non-slip paving possible, hard-wearing and extremely pleasant in appearance. The checker effect is given by setting the slates in each square (of

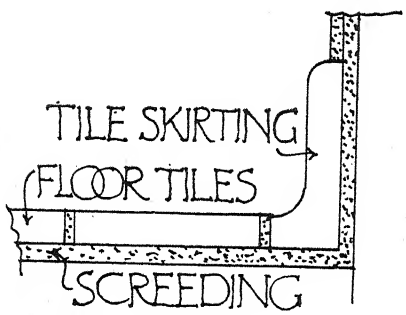

FIG. 43

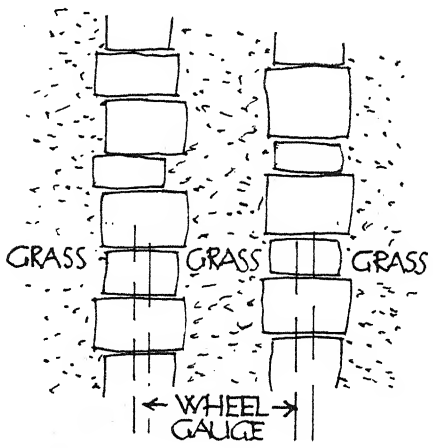

FIG. 43a

about 6 in. sides) at right angles to those in each adjacent square.

Stone Pavings (except in the form of crazy or square slabs to garden paths) are uncommon in modern domestic work, but may usefully be employed to minimise the bald effect of a motor drive-in to the garage. A grass path with stone flag wheel-runs will often serve its purpose for this in place of an arid expanse of tarmac or cement (Fig. 43a).

Tar and Macadam Pavings are sometimes necessary for drives or paths. It seems necessary to say that this final surfacing should always be deferred until the base, and any making-up of levels, have had ample time to settle and disclose weak or soft places.

MASON

THE POSITION OF MASONRY

The share of the mason in the ıilding of the average house has minished to vanishing point. Stone lls and steps are now uncommon, one copings hardly less infrequent, en stone chimney-pieces (which ıger on) are usually artificial stone ·livered, fitted together, and fixed :e other fireplaces by the bricklayer. In a few localities stone-built or ɔne-faced houses still occasionally ;e; around Bath ashlar facings are t uncommon, in some parts of ales and in North Devon and ɔrth Somerset modern rubble-built uses may be seen, but speaking ıerally the stone house is now in luxury class.

The reasons are readily apparent on ısideration. Primarily, since it be-ne customary that the small house ɔuld be built in the slightest ınner that can be relied upon to ·lude the weather and remain ucturally sound, masonry walls ve suffered a great handicap. To ɔrd reasonable security against ıetration of driving rain, solid sonry walls must be *at least* 16 in. :k; even that thickness has been ɔwn to fail during severe con-ıance of gale-driven rains. This ıns that in substance the walling material necessary is roughly double in quantity that requisite for 11 in. cavity walling in brick or cast slabs. Nor does the disparity end there. Such incidents as foundations, lintols or arches are all affected, and the larger area of roofing to cover the increased overall plan size caused by thicker walls is of much greater consequence in a small house than it would be in a large one, as shown comparatively in Fig. 44.

Obviously, conveyance of the extra material, and labour in setting and fixing it, represents uneconomic addition to cost which weights the scales against masonry construction as a common resort, even when stone can be had for the getting.

In those few favoured localities where rubble-walling remains possible, it becomes increasingly difficult to get masons who will treat it agreeably according to old fashions, growing unfamiliar. So much of the effect of plain walling depends on the jointing—its width, regularity, colour, and projection—that it is of vital importance to decide its form only after consideration of specimens sufficient in area to give an adequate idea of the general appearance from some

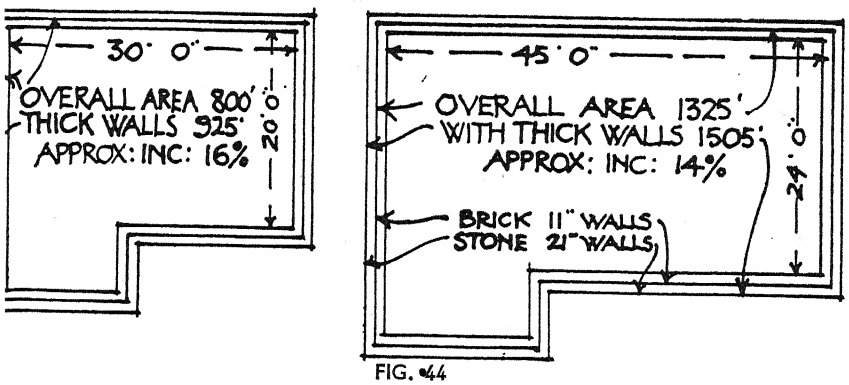

FIG. 44

distance. The varieties of rubble, both as to colour of material and shape of stones, are so many that any general rules seem well-nigh impossible, but perhaps it is safe to say that there are two forms which are always detrimental to appearance — black mortar, and " collared " pointing in which, along the middle of a wide joint varying according to the irregularity of the blocks, is formed a projecting mortar-fillet more or less even in width and twisting hither and thither as the jointing dictates—a distressing effect descriptively known as "snailcrawling."

SLATER AND TILER

GENERAL

These twin crafts are grouped in most specifications and textbooks, rather to the disadvantage of slating, which, from natural factors, possesses a different technique, though the principles of lap and bond are generally similar to plain tiling. The most concise and complete general epitome of slating and tiling practice can be obtained from Report No. 5, prepared by the Manchester Architects' and Builders' Consultative Board, and issued, price 1s., by J. Denver, 2 Conyngham Road, Manchester, 14.

Slated roofs, laid on the commonplace lines which blind adherence to ordinary textbook preference for " best Countess " renders inevitable, have suffered in consequence, and the esteem in which they might be held suffers further from the general outlook so produced, that a slated roof must necessarily be ugly — a view upheld by casual references from descriptive writers in guide-books and elsewhere. Of the practical merits of slating as a roof-covering no one is in doubt; of its æsthetic merits in certain areas and under proper control there should similarly be no question. This applies to practically all big-scale, open, hilly country such as South-West England, Wales, Derbyshire, the Lakes and adjoining parts of Yorkshire and Lancashire, and people have only to use their eyes without prejudice to see for themselves how harmonious the old slated roofs of those areas are with the colour and character of the landscape.

SLATES AND SLATING

The essential difference in technique between slating and tiling is due to the fact that slates are a natural product fashioned from cloven rock, and by their nature can only exist as flat riven slabs of greater or less thickness, whereas tiles, being plastically made, can be formed in any desired shape. The consequences are, of course, that while with tiling all intersections and margins can be dealt with by specially fashioned units, with slating leadwork and close-cutting are essential. Slates also rely on nails, without help from nibs or stubs. These are elementary facts, but seem not to be always fully realised.

The general principles of lap and bond, which decide the gauge of slating, do not need exposition—nor do the relative merits of head and centre-nailing, which have been expounded in every textbook. The important points upon which concentration should be directed if good appearance is desired are, briefly :—

SIZE AND TEXTURE OF SLATES

The size of slating should be directly proportioned to the pitch—partly for the practical reason that the steeper the pitch the greater the weight hanging on the nails and the leverage exercised by wind, and partly because steep pitches exhibit their coverings more prominently. For roofs of 50° or over either small regular slates 12 in. by 6 in. or random widths 12 in. or 14 in. long should be used, or, of course, " randoms " sized and sorted in diminishing courses from eaves to ridge always look well, but are costly. The lowest admissible pitches, something under 30°, such as may be seen in Regency houses, call for big (and particularly *wide*) slates especially near the eaves.

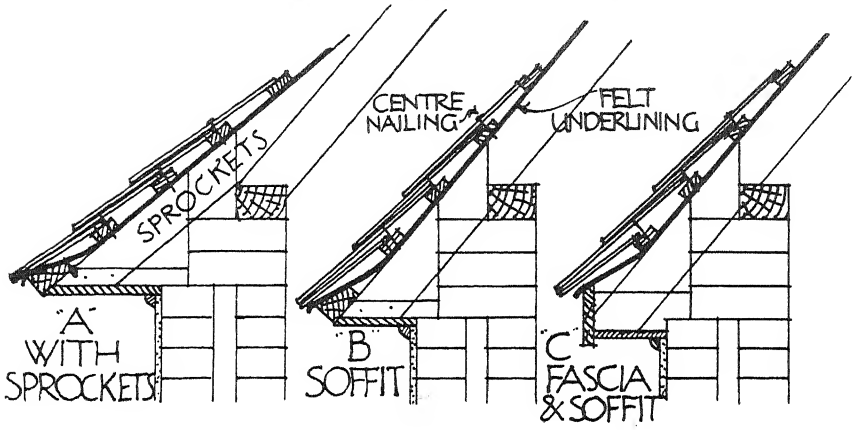

FIG. 45

Between these two extremes intermediate sizes are appropriate and can usually be recommended and supplied by reputable quarry owners, who welcome consultation and an outlet for the stocks of slates which they necessarily accumulate in unpopular sizes. The constant demand for 20 in. by 10 in. to the neglect of other sizes is irritating. Apart from questions of appearance, there is usually advantage to the tune of a few shillings per square in the use of slates not commonly in demand.

Apart from its individual surface, the use of a small-sized slate, from the greater number of edges visible, imparts a less smooth and mechanical appearance to a roof. This effect can be aided if the slater is instructed to reverse his usual practice and exhibit chipped corners at the tail of the slate instead of hiding them at its head. These methods will help a roof composed of slates having relatively smooth cleavage; should the slates possess naturally a rippled or dimpled cleavage the effect will, of course, be better still, and thickness (so far from being a detriment) gives further advantage. For all these reasons, the choice of a grade inferior to the trade "best" or "first quality" is to be preferred — provided, of course, that the actual slate rock, though not capable of splitting into the thinnest possible units, is sound and enduring. B.S.S. No. 680 (Welsh roofing slates) defines quality and tests and summarises the trade customs of the various Welsh quarries as to sizes and nomenclature.

Colour is of the greatest importance, since a roof is probably the largest block of colour uninterrupted in any house, and incapable of correction also. Greys, whether coldly bluish, greenish or inclining to buff are all agreeable. Sea-green wants handling with care in relation to its surroundings; purple slates, though usually of excellent quality, are better excluded from visible roofs. Cornwall, Wales and the Lake District all produce slates which might find a place on any building, while Scotland also has a considerable output of excellent slates which do not appear to travel outside her borders. There is really no excuse either for the exclusion of slates as a roofing for buildings intended to be of good appearance, nor for the use of materials unpleasant in colour, texture or by mechanical effect.

BATTENING AND TILTING FILLETS

Battens for slating should not be less than $1\frac{1}{2}$ in. by $\frac{3}{4}$ in., and 2 in. by 1 in. for heavy slating. An extra row of battening $\frac{1}{4}$ in. thicker than the general run should be fixed next the ridge to take the doubling course and

prevent it from "riding." Ample tilt must be given to the eaves, because, since slates have no camber like tiles, the tendency is for the initial tilt to be gradually lost so that the tails of the higher courses do not bite as they should upon the courses below. Sprockets and a "bell-cast" secure this necessary condition, which is also helped if the rafters are slightly concave, but the usual provision is either a tilting fillet or a fascia board adjusted in level so as to give the requisite tilt (Fig. 45). On the whole, a tilting fillet and soffit (without fascia) better suits the slim appearance of slating than the more heavy-looking fascia and soffit; but rafter brackets must be used to support the eaves-guttering instead of the easier fascia-brackets.

The position of the gutter relative to the edge of the slating is important. Roughly, the edge should lie centrally over the gutter, which should be set at such a level that a continuation of the roof surface would pass clear of its outer edge—permitting snow and the occasional deluge to shoot clear (Fig. 45a).

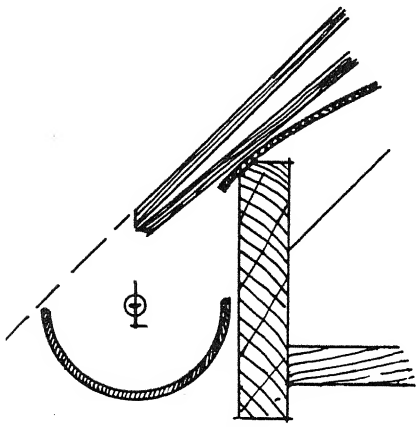

FIG. 45a

UNDERLINING

With the many reliable varieties of "untearable" felt underlinings now available it is never wise to omit this provision, which greatly increases the draught-proof and insulative properties of the roof. The felting, laid on the bare rafters and secured by the battens, should be lapped in direction of flow, and if any valleys occur it is good practice to lay one width of felting down the valley with the cut ends of the ordinary covering overlying it (Fig. 46). So disposed, trifling leakages which may be difficult to trace will never penetrate the roof. A line of plasterer's laths over the felting above each rafter serves as counter-battening and raises the actual roof covering to allow free escape of moisture and ventilation for the slating.

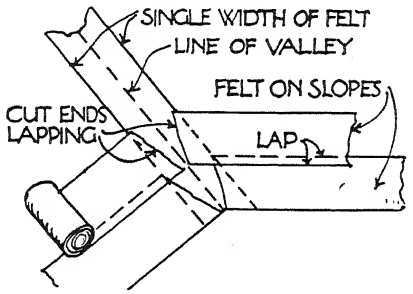

FIG. 46

FIXING SLATES

Nails.—"Slates last just as long as their nails." Copper nails or "yellow composition" are best in ordinary use. Galvanised iron or zinc nails should specially be avoided in sea air. Suitable length is important; if nails are too short there is a tendency to tight nailing which may shatter the hole or corner of the slate and cause incipient splitting which develops later; if too heavy the battens may be split. *To determine suitable length for nails add* 1 *in. to twice the thickness of the slate used. Large heads are important.*

SLATE-HANGING

Vertical Slating. — Dormer cheeks and gable ends may be covered with

vertical slate-hanging, which also in some exposed positions may profitably be extended over complete storeys. It should be remembered that the gauge can be greater than for roofing; it is sufficient if the lap is just sufficient to cover the head of the next-but-one course below—say 2 in. The slates will hang entirely on their nails, with little support by friction—they may in fact dangle in such a fashion as to produce irritating clattering sounds in gusty winds, and this should be provided against by bedding, for which a dab of plastic bituminous stopping is very suitable. In any case, the top-course below an eave should be fixed before the soffit-board, which should then hold and secure it. Where a gable-end finishes beneath a verge, a cut finish as described later for tiling is more secure than the usual triangular slates, and of pleasant appearance.

Circular, Conical or Octagonal Roofs may readily be slated but require a high degree of skill and care as all the slates must taper and, unless the upper courses are to become ridiculously small, bonding will be irregular.

MARGINS TO SLATING

Eaves.—Alternate eaves treatment has been described under *Tilting Fillets* and in Fig. 45. It is customary to bed the lowest course of slates upon the under-eaves course, but bedding should be excluded elsewhere.

Bedding Tile Ridges. — These are often bedded solid in lime and hair and pointed in cement, but this is a bad practice and should be discontinued. The mortar sucks up moisture and excludes air, from which causes the ridgeboard may rot or frost dislodge the ridge tiles. The tiles should be jointed and backed with about $\frac{1}{2}$ in. of 1:1 cement and sand mortar showing no mortar at the junction of ridging and slates—Fig. 47.

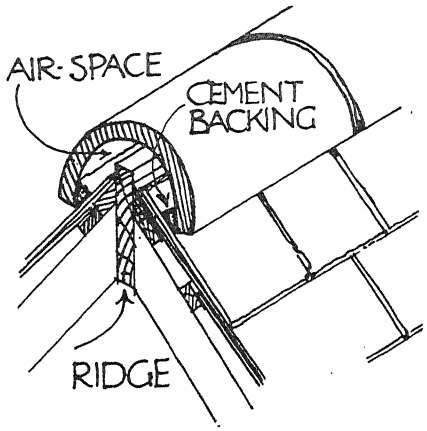

FIG. 47

Ridge.—The commonest of all the practices which deface a slate roof is the use of red ridge-tiles thereon. Slating firms have been slow to recognise this; otherwise they might have taken steps to render it easier to procure a preferable alternative. Blue Staffordshire half-round tiles make a suitable finish, buff half-rounds do quite well with some slates (e.g., Precelly), and dun-coloured (stained) ridges are less objectionable than a hot red. A lead ridge looks satisfactory but is apt to be disarranged in windy districts and is liable to stain the slopes of grey or green slating.

Verges.—The projecting verge of a slated roof is apt to look thin and poor, even when a single-course undercloak is provided. For appearance it is well to form the undercloak of doubled, or even trebled, slate as shown in Fig. 48, which gives

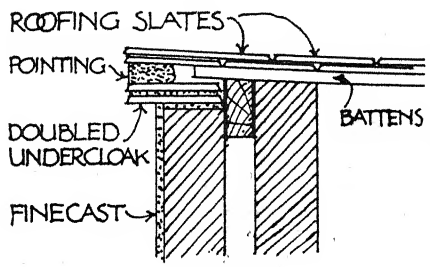

FIG. 48

a good stout verge capable of resisting damage from ladders. An upward tilt should be given to the verge to minimise possible over-running during heavy rains.

Valleys.—The open lead valley, which is commonly the form adopted with slate roofs, is not a necessity, and exposes the lead to the chance of damage by the effect of sun and movement, as well as cutting up the roof slopes in a manner inimical to the appearance of continuity which gives the best effect. If open valleys are used they should widen towards the eaves by 2 in. in 16 ft. to accommodate increased flow and to free any ice which may form. The mitred valley is, however, superior in appearance and equal in performance.

It can either be formed with individual soakers to each course, or, more easily, with crimped lead sheeting in long lengths as shown in Fig. 49, the crimping of the lead having the effect of preventing a rush of water from one of the intersecting slopes from surging up the opposite slope, as well as permitting expansion and contraction without the risk of splitting. No lead is visible by this method, but it is wise to restrict it to valleys not longer than 12 to 15 ft.—beyond that length the open valley is safer, unless "random" slating is used.

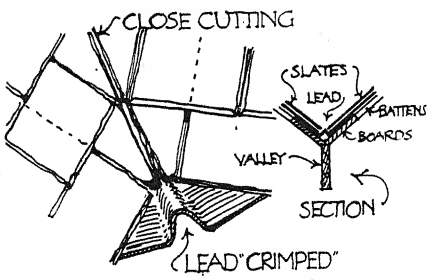

FIG 49

MARGINS TO SLATING

Hips.—Hips should be close-cut and mitred, using slates of sufficient width to preserve proper bonding. When the roof pitch is less than 45° lead soakers are advisable, in which case they should be of no thicker substance than 3 lb. lead; otherwise they cause the slates to "ride" and probably blow off. With steeper pitches a cheap and effective hip can be formed by nailing a 6-in. board on either side parallel with the hip-rafter, stopping the battens and pressing the mitred slates into oil mastic or putty as well as nailing in the ordinary way (Fig. 50). It should not be forgotten that no water runs over a hip—only such as actually falls upon it need be considered.

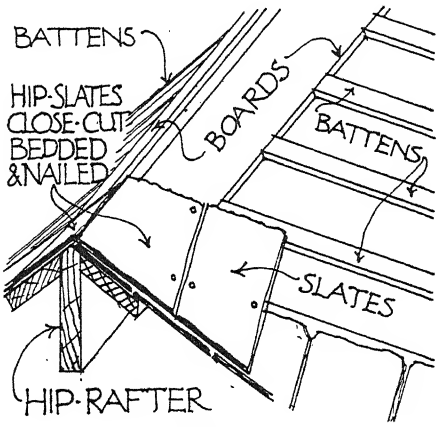

FIG. 50

Glass Slates.—A simple way of introducing light into a loft is the insertion of a patch of glass slates, but it must be remembered that the clear area will be very much less than

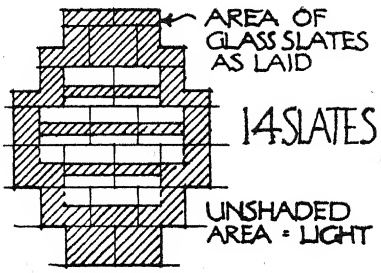

FIG. 51

the area of the slates. In practice nothing less than a group of 14 arranged diamond-wise is worth while in the smaller-sized slates, or nine when slates of round about Countess size are used (Fig. 51).

TILES AND TILER

Plain tiling, unlike slating, cannot receive any help to weatherproof quality by the increase in size of unit, which is standardised between 10 in. by 6½ in. and 11 in. by 7 in. From this fact, combined with the desirability of adopting a pitch which will throw off water quickly from the absorbent covering (as compared with slate, which is non-porous), tile roofs must not be laid to the lower angles permissible for slates. In practice, 50° to 53° is the proper tile pitch, but in a simple roof with short slopes and no valleys a pitch as low as 35° will usually keep out rain. The formation of valleys alters the problem, since the real inclination of a valley is considerably less than its adjacent roof-slopes, while the lap remains the same and the volume of water is much greater —particularly towards the bottom.

The characteristics of plain tiles are defined in two B.S.S., No. 402, dealing with Clay or Marl Plain Roofing Tiles, and No. 473 with similar tiles in concrete. Apart from essential qualities such as are defined by the Standard Specifications, *shape, texture and colour* remain matters of choice, and from the point of view of appearance are all-important.

CHARACTERISTICS OF A GOOD TILE

The shape of a plain tile may vary from the harsh regularity which might attach to a slab of boiler-plate to the uneven form of old-style local hand-made tiles. The latter produce the more interesting roof but call for higher judgment in the tiler. When given an underlining of untearable felt, which will check draughts and fine snow, tiles of irregular shape can safely be used and have the advantage that, from their lack of contact, water is not drawn up between them by capillarity. A good camber in length as well as a slight cross camber gives the best effect.

Texture is of paramount importance to the ultimate effect of a roof. The semi-glazed shiny tiles in hot reds, browns and purples which issue from many tileries in the Midlands have done much to deface distant parts of England. They never weather, but either remain " new " in appearance or merely become shabby. The same works commonly produce equally good tiles having a rough or sanded surface in softer colours, so that even if recourse cannot be had to the more expensive hand-made sand-faced tiles which are the ideal, there is no need for the offence which, all too often, glossy tiles produce.

Among the sand-faced class it is now customary to produce a range of stained colourings graduated from dingy black to the natural red, and many people prefer these as avoiding the raw effect of new tiling. It is questionable whether this is a wise policy; in a very few years of normal exposure the good sand-faced tile assumes agreeable tints preferable to those resulting from initial faked colouring. In any case, the " toned " tiles should be experimentally chipped to ensure that handling will not produce exposure of a contrasting colour.

" Specials " such as tile-and-half, valley and hip tiles, want watching for colour. Often they fail to tone with the plain tiling owing to variation produced by different firing.

Battening and Tilting Fillets.— Tile battens are normally lighter than slate battens, 1 in. by ¾ in. being common, and 1½ in. by 1 in. good average practice. If specification is by gauge rather than lap, the size of tiles should be specified—otherwise ½ in. less lap than anticipated may be secured.

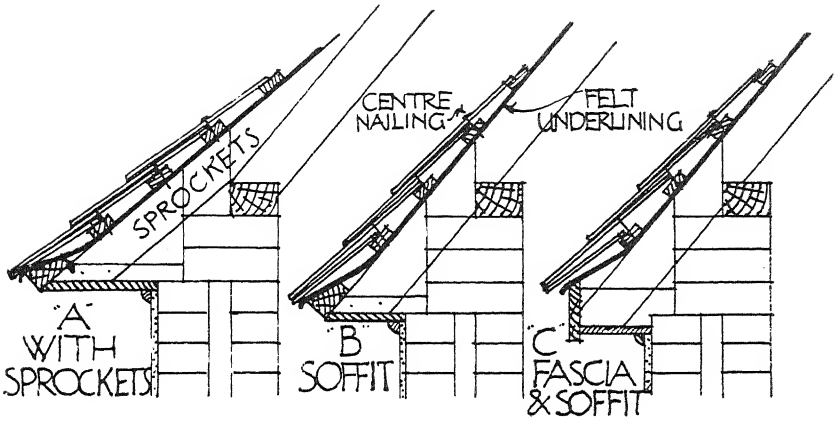

FIG. 45

The remarks and details in Fig. 45 are generally applicable to tiled eaves, but the more robust scale given by fascia and soffit may be accepted. Fascias, however, are commonly made too deep for appearance; 5 in. is ample.

Underlining can be similarly treated to the method shown in Fig. 46 and is even more necessary with tiles than under slated slopes, which lie closer.

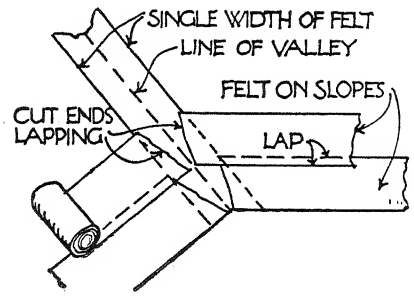

FIG. 46

Nails, owing to the presence of nibs on roofing tiles, are of less importance than with slating but should be of similar materials, 1¾ in. in length, 7 lbs. per 1,000. It is usual to nail all marginal tiles and every fourth, fifth or sixth course only of the plain slopes. The nailing of hip tiles of the granny bonnet form is very important and needs longer nails than the rest.

Mansard Slopes.—Though a roof of mansard form covered in slate requires leadwork at the change of inclination, the camber of plain tiles can be utilised to pass the angle without interruption, as shown in Fig. 52. In practice it is well to restrict the difference in slope to about 15°—say, 40° pitch for the upper slopes and 55°

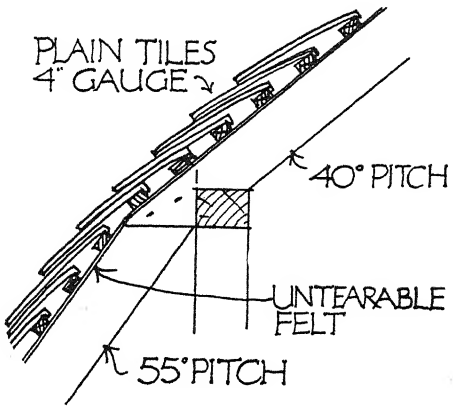

FIG. 52

below—not only because exceptionally cambered tiles would be required, but because the effect of much greater difference looks clumsy and forced. In conjunction with roofs of this form, dormer windows can be neatly formed by continuation of the upper

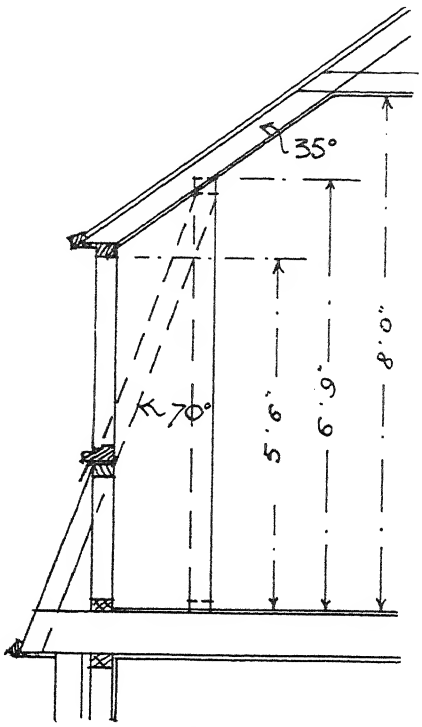

FIG. 53

slope as shown in Fig. 53, in which case the emphasis of the dormers allows a greater variation in pitch without the amorphous effect often produced.

WEATHER TILING

Vertical Tiling. — Weather-tiling, which is customary as a protective overcoat in south-eastern districts, can be applied to either framed or brick-built structures, a suitable gauge being 4½ in. Suitable methods of building "semi-hollow" walls intended to receive tile-hanging have been described and illustrated in Fig. 32a. Marginal finishes of tile-hanging are often insufficiently considered, resulting in crude or clumsy effects. The following points are worth special attention:

The bottom edge or "eaves," which normally will occur immediately above the ground floor window heads, requires a sufficient (but not exaggerated) tilt, and a close soffit—about 4 in. is sufficient for a two-storey house. The top edge under the roof should be completed before the fixing of the upper soffit, which then will lap and secure the topmost courses of tiles and show a regular gauge margin.

The top raking edge of gable tiling is best completed by the method now generally known as the "Winchester cut," in which the two end tiles in each course are cut fan-shaped instead of one tile as a triangle. By this method nailing is possible right up to the verge (Fig. 54) and an agreeable line is given.

Window-heads will normally lie either close beneath the weather tile eaves or that of the roof, but where a window occurs within a tile-hung surface an "eyebrow" should be formed by a similar tilt to that described for the lowest courses of the weather tiling.

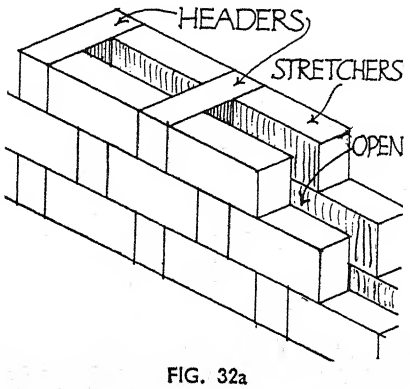

FIG. 32a

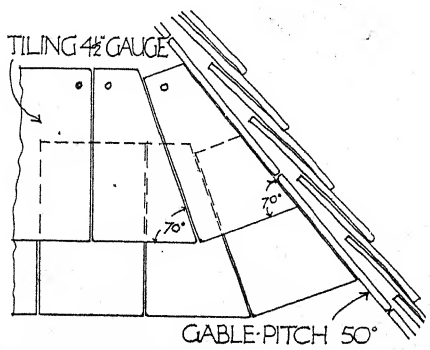

FIG. 54

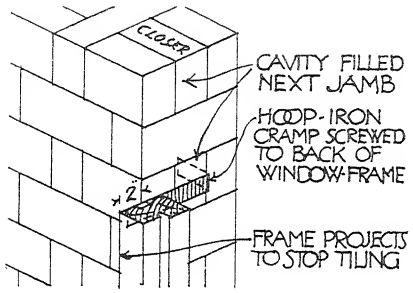

FIG. 34

Window cills should have a lead apron beneath, which should be cut to a true line in continuation of the most convenient tile course. Nathaniel Lloyd in his book on *Building Craftsmanship* described a method by which this obtrusive lead strip might be hidden, but this involves reliance on the adhesion of tiles to cement. Tiling abutting to jambs of window frames looks best (and is sound) if the frames are projected as shown in Fig. 34 so as to stop the tiling.

The front edge of tile-hung dormer-cheeks can be neatly and suitably finished as shown in plan by Fig. 55 (page 63). A carefully dressed lead soaker is required at the cill, cheek and roof triple junction.

External angles can either be formed by special angle tiles "handed" right and left or by close-cut and mitred junctions lapped alternately and pointed up. The former is the neater finish except for the rather "botched" effect which arises where the bottom edge tilt becomes accentuated at the corner, but a good tiler can ease things so as to give a good finish here.

ROOF MARGINS IN TILING

Eaves are finished with a special under-eave course, on similar lines to slating.

Ridges will be completed by half-round tile ridges matching the roof-tiling. The bedding and pointing procedure should be as described for slate roofs: Fig. 47.

Verges should have a tile undercloak arranged as described for slate, but it is a wise precaution to introduce also a course of slate, as many instances have occurred where water

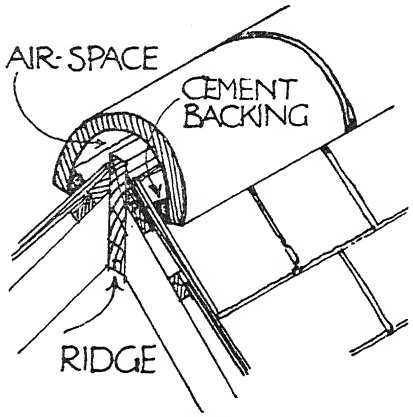

FIG. 47

has penetrated by saturation of the roof-tiling and undercloak where bedded solid on to brickwork, even though the equally porous tiles of the roof slopes have remained dry.[8] This is, of course, due to the intermittent evaporation of moisture from the ventilated roof slopes, whereas the bedded verges absorb continuously and become soaked.

HIPS AND VALLEYS

Any form of visible roof suffers in appearance when continuity of surface is broken—as by an open lead valley in slating or tiling. This is particularly so in roofs of minor buildings, where such incidents bear a bigger relationship to the whole. Plain-tiled roofs need never offend in this way if their pitch is adequate—say, over 40°—and fortunately the exact angular intersection type of valley tile which only fits its own precise pitch is falling into disrepute also. For ordinary use a rounded form of valley-tile not only

8 *B.R.S. Questions and Answers*, 1st Series, No. 4.

looks much better but is kinder in use as its fit is not spoilt by a few degrees difference in pitch.

There has been of late years a considerable revival in the use of the "laced" valley, formed by sweeping up opposing courses of the roof intersection so that they meet with the tile-sides at right-angles against a line of tile-and-half tiles set diagonally down the valley, as in Fig. 56.

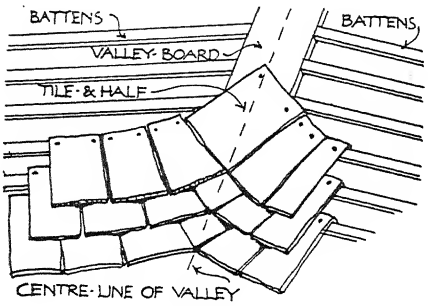

FIG. 56

A sole-board laid up the valley receives the intersecting courses, and a certain amount of packing and fitting is required to start the sweeps at the eaves, but expert tilers now fully understand this detail. The laced valley (which was traditional in many districts) broadens the space occupied by flowing water and lessens the local darkened stain which is apt to appear. It should be remembered that to secure a sound natural finish at the top of the valley, one roof should predominate; if ridges are on the same level there is awkwardness in finishing, whereas where a subsidiary roof intersects a main roof there is no difficulty.

The "swept" valley is more difficult to form and less craftsmanlike in idea. It involves sweeping round each course on the level so that each tile in the curve so formed has to be cut and fitted. It is hence very expensive, the time and skill requisite (particularly in starting and finishing) being very great. It is seldom used except in high-class work.

The cheapest hip-covering is the half-round ridge tile, the use of which obviates the need for exactly cutting and fitting the opposing courses which roughly mitre beneath its shelter. With certain types of design, notably plain rectangular plans with simply hipped roofs, this treatment is acceptably good; most tiled roofs are better treated with special hip tiles bonding with the courses. As with valley tiles, the exact angular intersection is discredited—bad fit is more likely and noticeable where precision is aimed at than where a certain latitude exists. For this reason, as well as for their more gracious lines, either rounded or "granny-bonnet" hip tiles are preferable, but the tendency to exaggerated boldness in the latter form should be checked; it results in needlessly big masses of bedding and pointing material between the tiles, which look clumsy and are apt to get disturbed by trifling movements so as to drop out in lumps after a few years and even may be dangerous when falling.

GLASS TILES

Glass Tiles are more noticeable than glass slates but can sometimes be

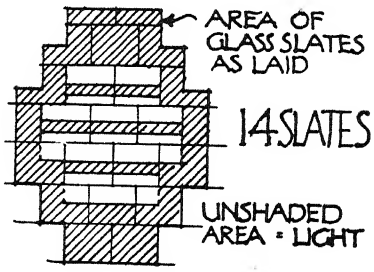

FIG. 51

conveniently used. They are subject to the same reduction of effective area (Fig. 51).

SINGLE-LAP TILING

Pantiles, Roman Tiles and Similar Forms.—These single-lap forms of tiling are applicable to simple roofs.

The common pantile, dependent for its weatherproof qualities under stress of severe weather upon some form of bedding or underlining, has had conferred upon it new possibilities by the introduction of the bituminised untearable felt underlinings. The various pantile forms of continental origin which embody in their design numerous ingenious (and not too visible) check grooves and throatings are also responsible for an increased use of pantiling.

The form of tile known as "double Roman," which is the biggest single unit in common use for roof covering (apart, of course, from asbestos-cement and iron products) is also justly popular in suitable cases. This form, which comes chiefly from Bridgwater, where the local clay burns without distortion, makes an inexpensive covering for simple roofs.

Several characteristics in design should follow the use of any of the above forms:

(1) *Scale should be bold; roofs not complicated or broken up by projections.*

(2) *Features such as dormers, chimneys, etc., penetrating the slopes should be adjusted in position and width to agree with a multiple of tiles as laid.*

(3) *Hipped roofs or parapetted gables are generally preferable to gables having open verges, as the tiles are right-handed and not symmetrical. Special verge tiles with an extra roll are, however, obtainable in some types to overcome this.*

In laying tiles there are differences in practice which should be observed.

Battening should be stout; 2 in. x 1 in. is a minimum, and it is wise to set out the gauge after receipt of the tiles, which are apt to have trifling variations from nominal sizes.

Nails are frequently not used, but it is preferable to nail or wire a proportion of the tiles to steady the whole arrangement against disorganisation by heavy gusts of wind.

Eaves should be bedded on an undercourse of plain tile or slate— otherwise sparrows and mice may gain access to the roof by means of the open ends of rolls.

Ridges and Hips will be covered with half-round ridge tiles, and the bedding of these produces a problem owing to the relatively large spaces between the roll-edges of the tiles which need filling. The old craftsman's practice of packing these with strips of tile has much to commend it both from appearance and practical result (Fig. 57). If arranged as shown, this can be referred to as "laminated filling."

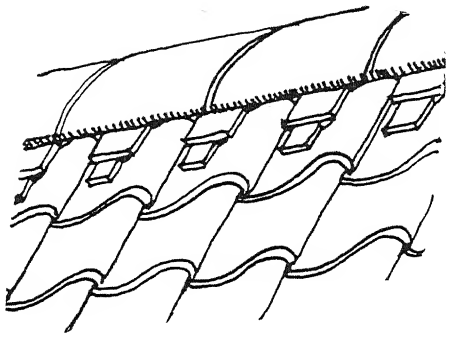

FIG. 57

Verges must have a tile or slate undercloak, but the difficulties referred to under (3) above should be borne in mind.

Valleys are most commonly formed in lead and open in form, but in some cases have been successfully made using a line of pantiles or a special socketted half-round channel tile. The open valley cuts up the roof (visually) in an unpleasant way, and the skew-cut tiles with their necessary fillings are a source of weakness if great care is not taken, hence the caution in (1) above.

Hips have been referred to above under *Ridges*. Stout hip-hooks are necessary at the bottom to secure the tiles against dislodgment.

Dormers of two-light width or less would mean an undue proportion of cut tiles, and are preferably covered with flat roofs and lead cheeks, or may be roofed in plain tiles

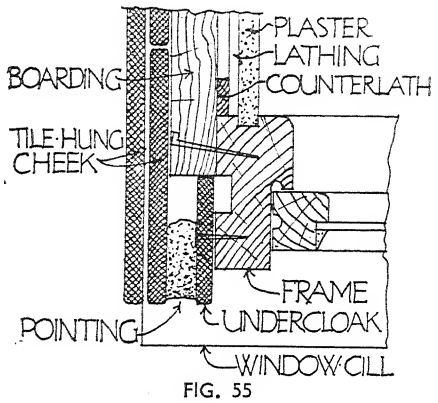

FIG. 55

with plain tile hanging to cheeks. Larger dormers can be less awkwardly covered, and may perhaps be roofed with similar tiles to the main slopes. The caution in (2) on the preceding page should be remembered.

Leadwork is more troublesome than with slates or plain tiles. Soakers cannot be applied to rakes or abutments, which must be covered by flashings, and both these and any aprons require dressing to the convolutions of the tiles, as well as greater width than usual.

Glass tiles are obtainable in most types, and unlike those used with slating or plain tiles, nearly the full area of the glass yields light, owing to the single lap cover at all edges.

SHINGLING

Shingling has made a reappearance in this country, owing to the importation of Canadian red cedar shingles in convenient form. This wood receives the highest possible commendation from the Forest Products Research Laboratory for durability and resistance to insect and fungal attack, and it weathers to a pleasant grey colour on exposure. Shingles are supplied cut to an even length (usually 16 in.) and random widths; any over 8 in. wide should be split before laying. They are slightly tapered in thickness from butt to tail, the thicker ends being exposed. When laid on roofs, a 16-in. shingle should expose 5 in. of its length—that is to say, the gauge is 5 in.; on walls it may be increased to 7½ in. The pitch of a shingled roof may be as steep as circumstances dictate, but not under 30 deg. Bonding follows the same general principles as random slating, a rough general rule being to break all joints in sidelap at least 1½ in. Shingles should not be laid with a close joint, but spaced from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. apart. To ensure the maintenance of this spacing under all conditions it is recommended that the shingles should be soaked before laying (so as to swell) and laid wet. If the joints are close and the shingles later swell, their arrangement may be disorganised and their tight-fitting edges encourage capillarity. Each shingle requires two nails only, and these should be copper, and driven in from $\frac{3}{4}$ in. to 1 in. from the sides and approximately 1 in. above the exposure line. It will be seen from Fig. 58 that each nail penetrates two layers of shingling. Points where technique necessarily differs from that appropriate to slating are:—

Battening should be wider, something between slate battens and close boarding. 1 in. by 3 in. or 1 in. by 4 in. battens, spaced at 5 in. centres, give the necessary adjustment of support and ventilation.

Eaves are doubled with full-length courses (Fig. 58).

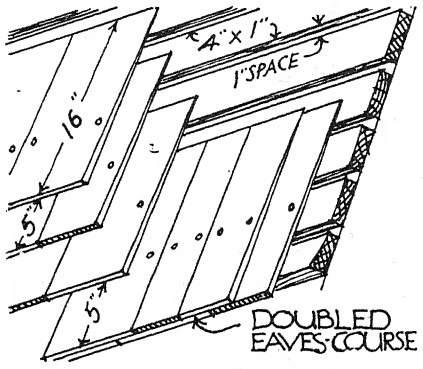

FIG. 58

Ridges and hips are laid close and covered with an additional double

line of butted and lapped shingles laid parallel in direction to the ridge-board or hip rafter, as shown in Fig. 59.

Valleys are close cut over a concealed metal gutter. Hips may also be close cut *without* the external covering course, by using metal soakers.

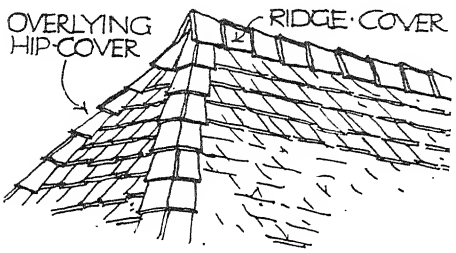

FIG. 59

Verges finish similarly to slating, using wide shingles in alternate courses, with an equivalent to the slate undercloak in the form of a strip of boarding (which should also be red cedar) projecting as a soffit.

COSTS

For comparative purposes the following prices may give some idea of relative costs, but it must always be remembered that cost per square in plain roofing represents only a portion (sometimes little more than half) of the total cost, dependent on complications and the marginal charges additional to the rate per square.

London Prices	£ s. d. *Per square*
Machine-made sandfaced tiles, 4-in. gauge on 1-in. by ¾-in. battens, 4th courses copper nailed ...	3 3 6
Hand-made sandfaced tiles, ditto	3 10 0
Sandfaced pantiles, 10-in. gauge on 2-in. by 1-in. battens, not nailed ...	3 0 0
Double-Roman tiles 85 to square on 2-in. by 1-in. battens, not nailed ...	2 6 6
" Sterreberg " interlocking pantiles, 11½-in. gauge on 2-in. by 1-in. battens, not nailed	3 2 6
Grey Welsh slating, 14 in. by 8 in., 3-in. lap on 1½-in. by 1-in. battens, copper nailed	3 10 0
Delabole grey-green, 14 in. by 8 in., 3-in. lap, ditto	4 7 6
Cedar shingles, 5-in. gauge on 4-in. by 1-in. battens, copper nailed	2 15 0

CARPENTER

MATERIALS AND GENERALLY

The carpenter is concerned with the supply and fixing of the carcassing timber used in building, and also (increasingly) with the temporary formwork in which *in situ* concrete construction is cast, and such items as centerings for arches and temporary supports generally. The timber for the latter uses need not concern us, as it is a matter of " use and waste," so that quality is of minor importance.

As regards the timbers in principal use, these are in the main softwoods, though a certain amount of oak is used for beams and framing. Baltic redwood and British Columbia Douglas fir are the species chiefly employed in house-building. B.S.S. No. 589 (Nomenclature of Softwoods) and No. 565 (Terms and Definitions Applicable to Softwoods) give clear descriptions, and the numerous publications of the Forest Products Research Laboratory are the most valuable source of reliable information upon timber characteristics.

The aspects which will principally concern the housebuilder are briefly phrased in the average specification, which calls for " sound redwood of suitable building quality, well seasoned, free from wrack or deadwood and discoloured sapwood, and sawn die square." Oak is usually defined as " well seasoned and free from serious defects."

SUITABLE BUILDING QUALITY

Somewhat to expand these requirements, suitable building quality may be held to exclude the presence of large, loose, or dead knots, and serious shakes which would detract from the strength or stiffness of the timber. Wrack or deadwood (trees which have been standing dead in the forest) will sometimes have the appearance of being sound and well seasoned heartwood, but can be detected by its different note when struck on the ends with a hammer; it is brittle and lacking in resilience, and may indeed snap like a carrot under load. Discoloured sapwood (blue stain) seems not in itself to be harmful, but it is evidence of the presence of sap, which in more than the slightest proportion should be excluded. Timber showing sap on *both* edges indicates conversion of small (probably immature) trees. The presence of wanes is certain evidence of inclusion of the whole of the sapwood in the section. The importance of even dimensions and a truly rectangular section " out of winding " throughout the whole length of a scantling needs no emphasis. Douglas fir, when first placed on the British market, was noticeably erratic in these respects, which caused difficulty in fixing, and in laying floorboards, but this serious drawback has been removed.

SEASONING

The term " well seasoned " is a vague one, though skilled men may know what it means. A better definition is the prescription of a percentage moisture-content proportioned to the use which is to be made of the timber. The definition of moisture - content is a simple matter. Cross sections $\frac{3}{8}$ in. thick cut from the scantlings and exposed for four days should be carefully weighed to obtain " initial weight." They should then be dried in an oven at

100 degrees C. until repeated weighings show no further loss of moisture; this gives the "dry weight." The percentage moisture-content is then calculated as follows:—

$$\text{M.C.\%} = \frac{\text{(initial weight) minus (dry weight)}}{\text{(dry weight)}} \times 100$$

In carcassing work the objects of seasoning are the reduction of inevitable shrinkage after fixing, and ensurance of a condition which will not favour fungal attack such as dry rot. Under both heads a suitable degree of seasoning can be defined as 19%-20% moisture content. In this state the amount of further shrinkage which is likely to follow the change from outdoor to indoor conditions should be very slight—a 9-in. Scots pine joist may shrink to 8.92 in. if quarter sawn, or 8.84 in. if slash sawn.[9] It may be necessary to explain that "quarter-sawn" timber is converted with the depth of the section at right angles to the annual rings, that is to say from a quarter of the original trunk radial to the centre, while "slash-sawn" divides the trunk into parallel slabs irrespective of radius. Investigations into conditions favourable to the inception of dry rot show that this will not develop unless the moisture-content of timber rises above 20 per cent. It is worthy of remark in passing that it has been authoritatively stated that it is more important that the construction of the building should be well designed than that the timber should be absolutely free of infection.[10]

There are points, however, where timber will necessarily be brought into contact with moisture, such, for instance, as upper storey joists built into 11-in. cavity walling with their ends open to the cavity. It is important that such parts should be thoroughly treated with a preservative before fixing, since fungal infection is certain to appear sooner or later on any timber remaining in a condition suitable for its development.

9. *Forest Products Research Record No. 5*, "The Moisture Content of Timber in New Buildings."

10. *Forest Products Research Record No. 14*, "Dry Rot Investigations in an Experimental House."

APPLICATION OF SCANTLINGS

In the application of converted timber to ordinary building uses it is well to remember that floor joists having a natural camber should be laid with the camber upwards, but that slates will bed better if rafters lie slightly hollow, so that any camber in this case should be downwards. Edge knots should be so disposed as to lie in whichever face is in compression—the top of a joist or beam and the bottom of a cantilever.

Elm is seldom used except in weatherboarding, as to which notes will be given later. Western red cedar weatherboarding shares with elm the property of weathering to a cool grey and requiring no preservative. It appears immune from insect or fungal attack and devoid of knots.

OAK

Oak possesses the inconvenient habit of developing fresh movements each time a surface is newly worked. English oak inevitably opens up new shakes and often a network of fine surface cracks when exposed to weather, but these are usually harmless, and need not occasion concern apart from their appearance. They appear to arise from the density of the timber resulting in surface drying or "case-hardening," which produces internal stresses. Large scantlings such as posts or studs may have their liability to shakes reduced if a 1-in. hole is bored centrally down their length. The liability to small surface cracks or case-hardening can be reduced if timbers are thickly coated with limewash when first worked; leaving the coat on as long as possible.

GENERAL DESIGN

Good or bad shape in a house appears to depend primarily upon the

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design of the roof and its relationship to the walls—except, of course, in the case of flat-roofed houses, where the roof has no visual existence. It is the chief difficulty of small house design that the economical square plan tends to produce uninteresting shapes —the pyramid if hipped, the wedge if gabled, or the crude box if flat roofed. In the aim to secure breadth of design, rather than a stilted lankiness, length of ridge and proportion of all elements so that horizontal components predominate are the most potent factors. A small detached house designed on these lines will generally look its full size or more, whereas upright proportions on a small scale have the reverse effect, and pyramidal roofs detract still further from apparent size. The roof design (based on plan) is thus all-important.

In conjunction with the foregoing considerations, care should be taken that any house does not look either " over-hatted," or noticeably the reverse; the former specially offends a sense of proportion, and the latter is puzzling and suggests some fake. How far it is the effect of custom and usage that pitched roofs having a span much over the traditional cottage span of 16 ft. strike most critical observers as somewhat overpowering when surmounting houses of two storeys must remain a matter of speculation. A flat roof, which gives no clue to the depth of any building is, of course, freed from such incidental limitations.

Modern resources in materials permit several devices to restrict apparent span, while retaining the economical square plan. The ridge of a roof pitched at 50 deg. over a span of 16 ft. between walls rises to a height above wall-plate of about 9 ft. 3 in., which gives a length of rafter of about 14 ft., including eaves overhang. By curtailing the pitched slopes so as to have a ridge at this height, by the method already shown in Fig. 40, the centre space being covered by a flat, " over-hatting " and the pyramid shape are avoided, while the space between ceiling and flat permits extra rooms of bye-law height to be economically formed if desired within the roof.

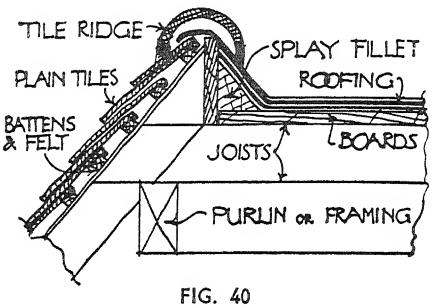
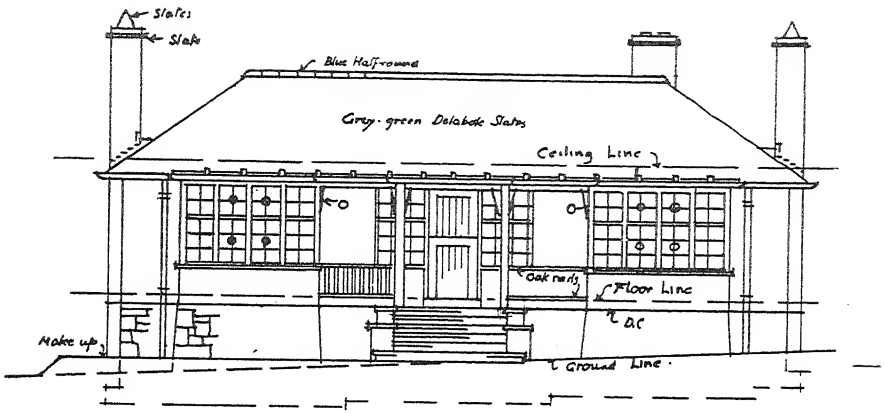


FIG. 40

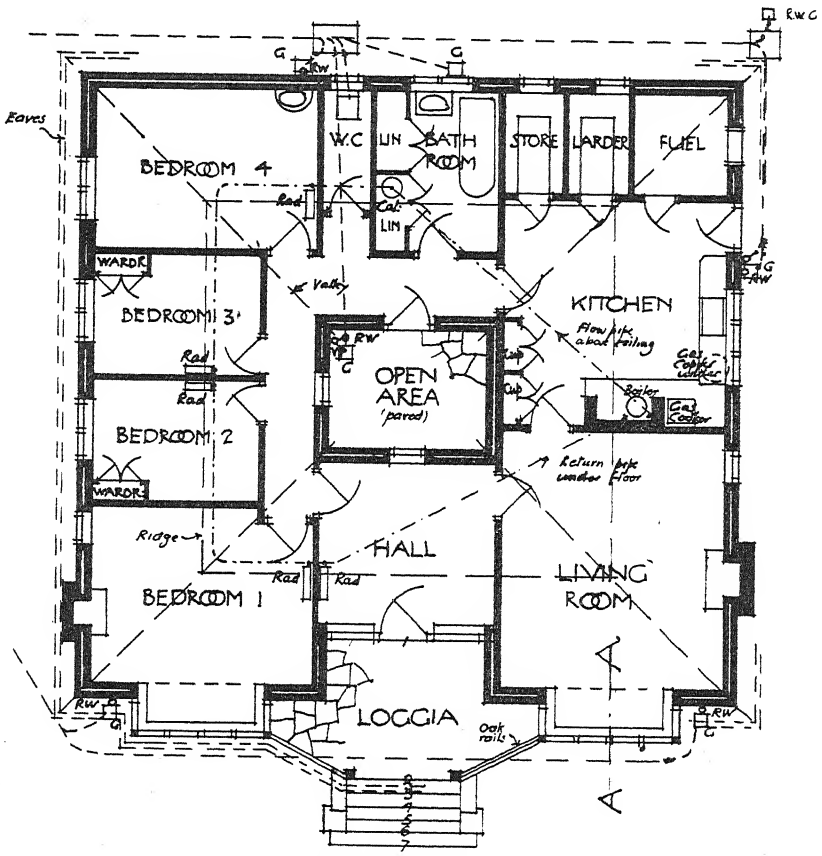
In a bungalow, an internal court (which would be a deep light well in a house of equal or lesser ground area) achieves similar ends even more satisfactorily (see Fig. 60), since it introduces much-needed light into the centre of the plan.

FLOORS

The first job which the carpenter is called upon to perform in the average small house is the construction of the upper floor. In ordinary practice it is unusual for this to be other than a single-joisted floor, and for planning where the maximum clear span does not exceed 12 ft. there is little advantage in any other system. When, however, a single room having its least dimension much in excess of this figure is introduced, the occasion for careful thought at once arises. Is the joist-depth over the whole storey to be increased to that necessary to span safely the greater dimension of one room, or is ingenuity to be exercised to reduce the effective span of the larger room so as to bring a lesser scantling into use? The third alternative—that of using joists of varied depths according to span—generally produces complications which makes it better dismissed. It must be remembered that it is vibration and deflection, with their effects on plaster ceilings, which have to be considered, rather than actual safety against failure under stress. In most



SOUTH ELEVATION



GROUND PLAN

FIG. 60

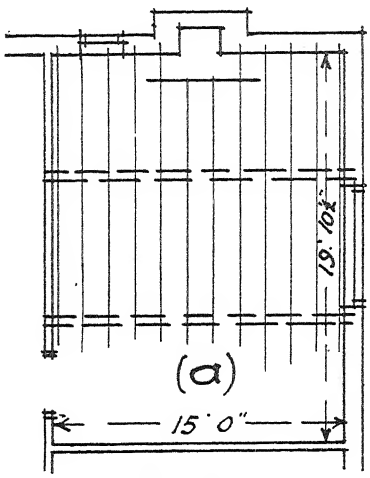


FIG. 61a

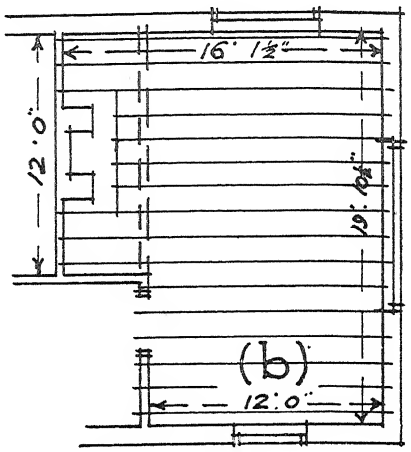


FIG. 61b

instances where one room is markedly bigger in area than the remainder, the smaller spans may economically set the standard, and the bigger area be more interestingly covered by joists of similar depth with intermediate bearings on beams—either dividing a rectangular room as in Fig. 61 (*a*) or by planning an L-shaped one as in (*b*). The latter shape offers facilities for attractive arrangements, which specially conduce to comfortable furnishing. It should never be forgotten that 3 in. saved on joist depth means also one course off the height of walls and an easier stair.

BEAM FLOORS

The beams provided in this type of floor need not always be oak; they can be built up of ordinary sections of fir joists, or can be R.S.J. hidden in the floor depth—though this latter expedient in minor work will always seem akin to a confession of failure in design. If oak beams are employed it will often be found that the edges have some portions waney, and here (and possibly elsewhere) a thickness of sapwood. By chamfering the lower arrises throughout to the extent dictated by the maximum wane, these defects can be removed, and a less crude form imparted to the beam. Sapwood in oak encourages the attack of wood-boring insects, which seldom attack heartwood, except by extension.

Beams built up from 9-in. or 11-in. deals, wrot where exposed, and with an edge-moulded soffit-lining below, can be materially stiffened by a concealed truss of hoop-iron, fixed as shown in Fig. 62, placed in tension by forcing two distance pices, X and

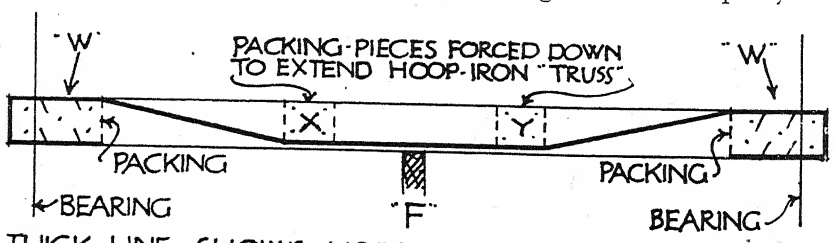


FIG. 62

Y, into position after the ends have been strongly secured. This expedient is not one for common use, but is sometimes convenient when it obviates the need for obtaining (and perhaps waiting for) special scantlings.

WALLPLATES AND LINTOLS

In external walls these are now usually and preferably not timber—except the roof plates. Upper floor joists may be built in (ends creosoted), resting on a strand of hoop iron; lintols will be concrete. On internal walls and partitions, however, timber plates and lintols are still frequently used, and with less objection. This is, perhaps, the convenient place to express the opinion that one of the advantages which would follow general adoption of B.S.S. No. 459 (doors) would be that all internal lintols might be bedded at the same level to provide for doors 6 ft. 6 in. in height.

ROOFS

As already mentioned, it is upon the general shape of the roof that the design of the small house depends for its "homely" effect, and for its appearance of suitability to site. When deciding on the external form of the main roof of a detached house on traditional lines, much more careful consideration than seems usual should be given to the roof considered in terms of modelling, so as to secure maximum length of ridge, definite ascendancy of the main span over projections, and incorporation of outbuildings so as to support the total design rather than seem mere excrescences or afterthoughts.

Existing bye-laws current in many districts are often found to hamper architects in the design of roofs which comprise habitable rooms, and their causeless variance from place to place is irritating. The new clause in 1937 Model Bye-laws should be welcome—it avoids several absurdities. The clause reads: "If a room is a room wholly or partly in the roof of the building, it shall be eight feet at the least in height over not less than one-half of the area of the room, measured at a height of five feet above the floor level of the room." This presumably leaves builders at liberty to omit the ashlaring which (under former sections) they were often forced to construct in consequence of a proviso that heights were to be "in no part less than five feet"; thus restricting attic storeys of space which would have proved useful, and creating lumber-holes and inaccessible rat-runs (see Fig. 63).

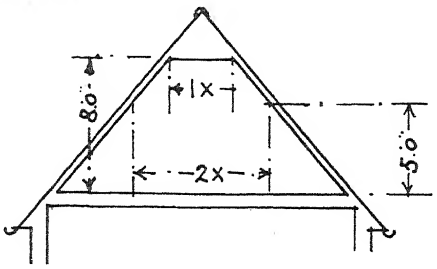


FIG. 63

Speaking generally, and with full remembrance of the dependence of every single design upon individual preference and external controlling factors such as surroundings and aspect, the two most useful expedients for lengthening a ridge and lowering the eaves-line of a roof are:—

1. To spring the roof at a lower level than ceiling height—something between 5 ft. and 6 ft. 9 in.—running out the gable-ends either gabled or "half-hipped," so as to secure full height and ample window heads. The effect both on ridge-length and eaves height is shown by plan and section in Fig. 64, in which the dotted lines show a plain hipped roof with ceilings at 8 ft. and the heavy solid lines the result of the course above described.

2. Arranging one-storey outbuildings, such as garages, loggias, fuel stores and tool houses as continuations

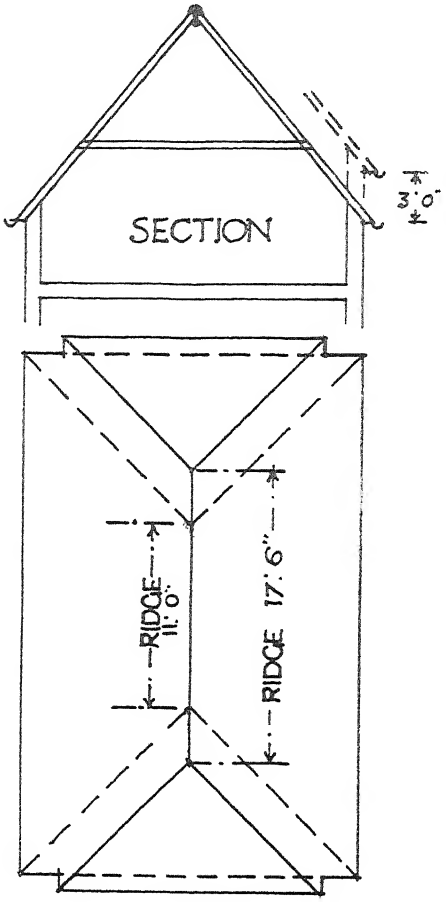


FIG. 64

of the main roof slopes rather than as obvious lean-tos. This practice requires forethought and scheming, but is often an economy as well as an æsthetic improvement. Quite frequently slight extensions of the required projection can be obtained without cost in the manner shown comparatively in Fig. 65, where the elimination of thicker walling which becomes in part external, pays for valuable increase in usable space, or enables a second lean-to elsewhere to be dispensed with by incorporation of its object. A word of warning seems necessary against an absurdity frequently perpetrated. A rundown or "catslide" roof, such as described, which is pierced by a dormer window

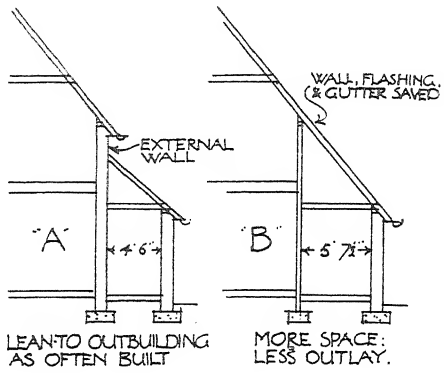


FIG. 65

occupying almost its full width, fails of its æsthetic object by the obvious futility of its scheme. Any dormer which approaches nearer than roughly its own width to the margin of the roof it penetrates, raises natural feelings of doubt whether appropriate design has been reached (Fig. 66).

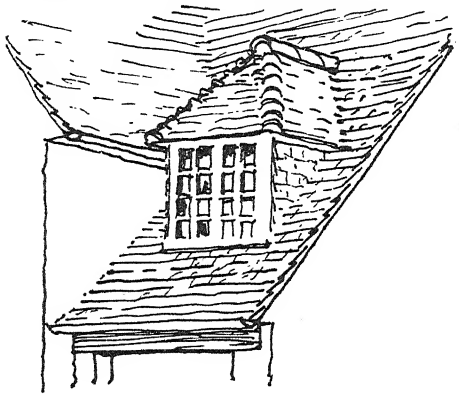


FIG. 66

Coming now to the details of roof construction:—

RAFTERS AND CEILING JOISTS

These are almost universally of 4-in. by 2-in. scantlings in the class of work under consideration. In this size moderate lengths are much easier to procure—about 14 ft. seems the optimum—as longer sticks probably have to be cut from trees of larger growth which can more profitably yield bigger scantlings. Restriction of

rafter and collar lengths to 14 ft., therefore, makes things easier for the builder. Long slopes with intermediate bearings need not, of course, have rafters continuous from eaves to ridge.

HIPS AND VALLEYS

These must be deeper so as to contain the oblique cut of rafter heads and feet, and valley rafters also need strength, since they bear considerable weight. The ridge board, on the other hand, is merely a convenient means of joining opposing rafters, and can be light in section, but it is preferable that it should be uninterrupted, a placing of chimneys so that they rise *against* rather than *through* the ridge having much in its favour.

COLLARS AND PURLINS

Collars serve alternately as ties or struts according as wind pressure develops. As commonly used they depend on nailhold only, the orthodox " dovetail-halving " being impracticable where scantlings are reduced to the minimum. An occasional doubled pair of rafters clipping the collar, in such positions as either side of a trimming for a dormer, is worth-while to stiffen up a roof.

Such purlins as may be necessary are commonly supported by a random arrangement of struts, bearing upon partition heads, chimney-breasts, or any other bases which offer. In a good many cases which have been seen, purlins much beyond requirements are actually supported by the roof which they professedly strengthen, and though some stiffening effect may be gained, weight and thrust are increased. The virtues of a trussed purlin arrangement for the loft space should be more generally recognised (Fig. 67). Such structures built up of relatively light scantlings on the lines of stud partitions have both strength and stiffness, and do not encumber the central roof space, which it may be possible (if not at once, at some later time) to use profitably.

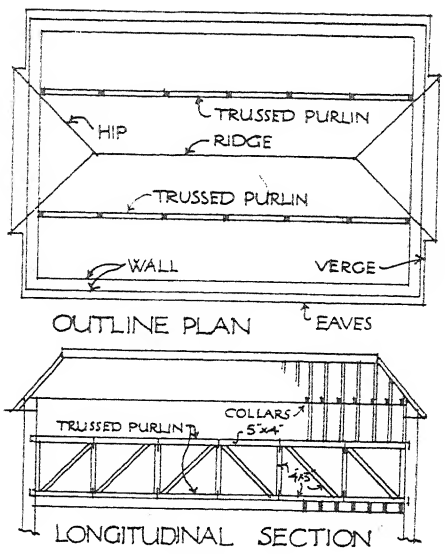


FIG. 67

CEILING BEAMS AND STRUTS

Ceiling joists (whether direct ties or collars) often span distances which are beyond the scantling employed. In such cases intermediate stiffening and support is advisable, and this may take the form of a deep joist above the ceiling joists, crossing their direction. The attachment of such a stiffener at intervals by a vertical drop-tie or hanger fixed to the ridgeboard greatly helps general rigidity. Such a beam also offers the opportunity for efficient strutting of purlins, where the trussed-purlin scheme referred to is not adopted.

ROOF BOARDING

Roofs which are boarded beneath slates or tiles can have their stiffness considerably increased if the boards are laid diagonally, parallel with hips and valleys, rather than parallel with ridge and eaves. Boarding so disposed serves also as efficient wind-bracing. Such disposition also has the advantage that the direction of the battening is not coincident with joints of boarding.

FIRRINGS TO FLATS

In order to impart the necessary falls to combinite or asphalted flats it is usual to fir up on joists which have been fixed level. An alternative course which has some points to commend it, is for the joists to be laid to the requisite fall, with a false ceiling suspended beneath where a level soffit is essential. Such a course admits better insulation and affords some space for passage of pipes and wires.

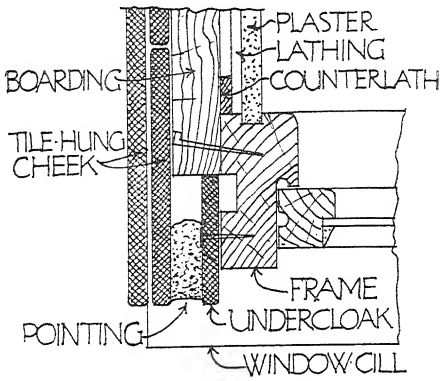


FIG. 55

DORMER CHEEKS

Shallow dormers and half-dormers projecting from the eaves of a house roof are commonly made needlessly clumsy in appearance by the construction of spandrels of studding, which

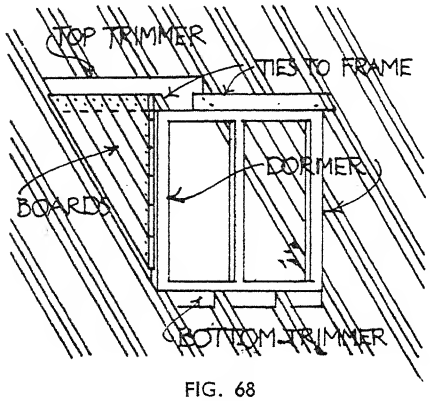


FIG. 68

necessitate a coarse coverboard at their front edge. Any dormer 4 ft. high or less can be neatly and efficiently enclosed by stout boarding — say 1¼-in. g. and t.—nailed on parallel to the roof slope as shown in Fig. 68. Soakers laid with slating or tiles are turned up against the outer face and covered either by tile or slate-hanging or lead cheeks, and the internal and marginal finish is as shown previously in Fig. 55.

CHIMNEY GUTTERS

The formation of a lead gutter behind a chimney stack is a frequent means of introducing dampness from heavy rainfall splashing off the roof slopes saturating the chimney brickwork. A safer and more agreeable practice is the formation of minor intersecting roofs behind any chimney which rises from eaves level. Not only does this overcome the risk just mentioned, but it gives the chimney the appearance of support, mitigating the stalky look which a chimney in this position and of adequate height appears to have. It is needless to prepare for such roofs by orthodox methods — two short layer

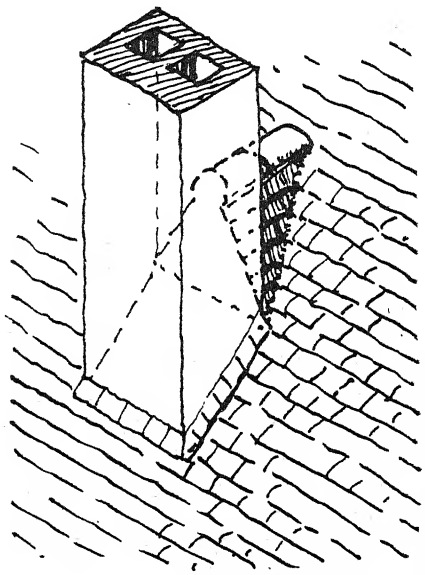


FIG. 69

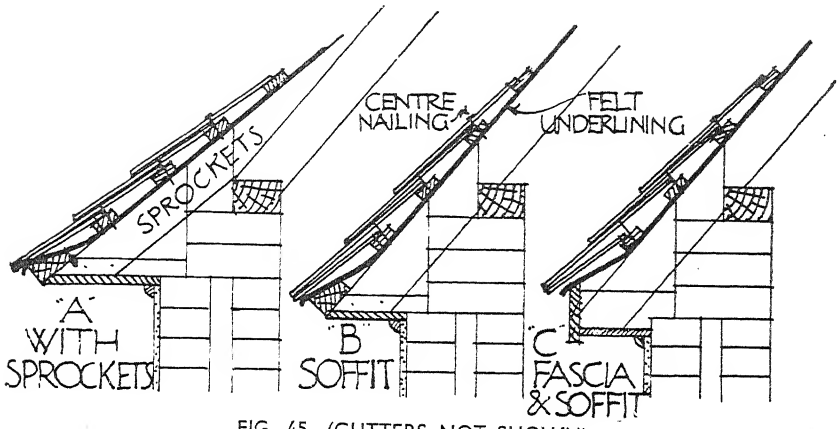


FIG. 45 (GUTTERS NOT SHOWN)

boards on the roof slopes to receive the jack rafters are all that is needed (Fig. 69).

SOFFIT BOARDING AND FASCIA

Details which have been given in Fig. 45 should be referred to. Asbestos-cement sheets or one of the hard boards make a very good substitute for soffit-boarding or plastering. It should not be overlooked that the introduction of sprockets affords a means of getting increased height above floor level for window-heads, where that is desirable.

In conjunction with the "half-hipped" form of gable developed by the device shown in Fig. 64, it is a useful and pleasant-looking detail to allow increased eaves projection up to double the normal (still further lengthening the ridge), keeping the soffit close down over the window-head. This practice allows casements to be fully opened without rain drifting in, affords a measure of shade when the sun is high in summer, and greatly invigorates the design. Sprockets should *not* be used as part of this feature—they cause ugly and risky complications where the short returns of the hipped projection intersect the verges of the main slopes.

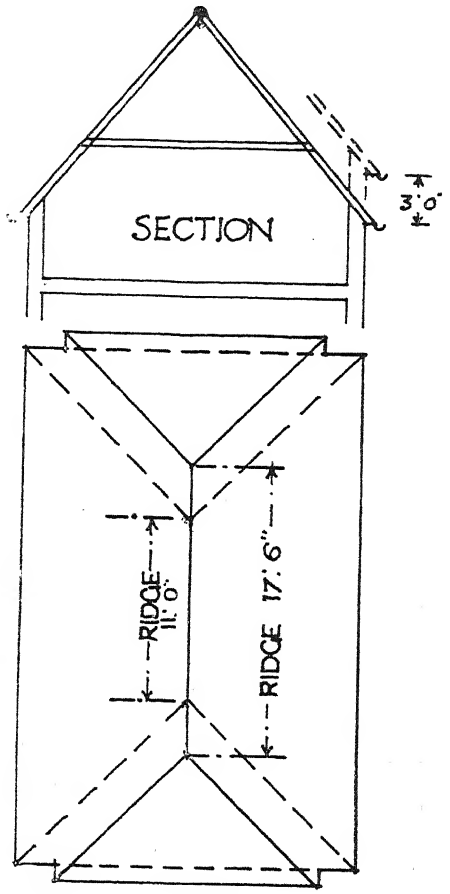


FIG. 64

BARGE-BOARDS

Neither the barge-board nor the humbler verge-rafter is often employed in modern design; it is at any rate a matter for thankfulness that the club-footed barge-board, supposed

"ornamental" by the Victorian builder, has disappeared; no more clumsy or stupid detail developed from the Gothic Revival. Where barge-boards *are* introduced (and there are occasions when their use is rational) it should be remembered that a mitre-joint at the apex is poor practice, and is certain to gape after a few months' exposure. Barge-boards and ridge should be housed into a gable post (Fig. 70), covered by undercloak, tiling and ridge, and terminated below by some form of drop. This makes a sound job, which, incidentally, conforms to the admirable mediæval practice of avoiding coincidental joints. This may be the best place to remark on the good sense of this practice. "The strength of a chain is that of its weakest link." Similarly, the strength of a timber is its slenderest part, and that is normally the place where it is cut or mortised for jointing purposes. If members of a framed structure do not coincide in their joints, strict triangulation may not be achieved, but a stronger frame can result. The wagon-chamfering of old farm wains probably arose from a recognition that the reduced substance at joints was the measure of strength, so that superfluous timber (and weight) could be profitably reduced in the uncut sections between.

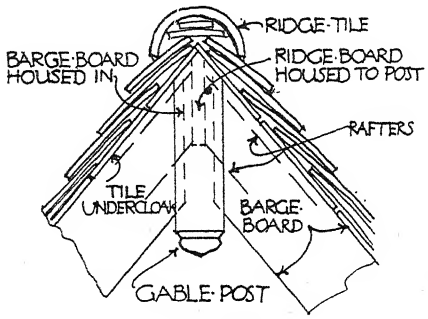


FIG. 70

WEATHERBOARDING

Apart from actual weatherboarded houses, there are opportunities for the use of weatherboarding or "siding," in such positions as the gablets over dormers, gable-ends above the topmost windows, out-buildings, spandrels of run-down loggias, and similar positions where a filling is required. The choice exists between a rustic form of boarding such as sawn elm or oak (appropriate in some situations such as occur with multi-colour brickwork) and a more refined wrought, rebated and possibly edge-moulded boarding intended to be painted, which looks well with plastered or distempered brickwork. Both types of boarding should be backed by bituminised felt, preferably fixed over diagonal grooved-and-tongued boarding, nailed to studding.

ELM

Elm has inconvenient propensities to shrink—a great deal in width and, to some extent (uncommonly) in length also. It also twists and casts very powerfully in drying, and changes its nature during the process from a softish material easily nailed to one of unyielding substance with a tendency to split during nailing. These characteristics dictate several precautions:

1. Boards should be used in single length without butt-heading joints. If such joints are inevitable, copper or zinc tingles should be fixed under each.
2. The boarding should be nailed on "green" as soon after it is converted as possible, while it is easily nailed and before it has cast.
3. Lap should be ample to allow for shrinkage—3 in. is not too much.
4. "Feather-edge" boards greatly increase liability to severe twisting, as the thin edges dry out quicker than the thick, and often split.
5. Holes should be *bored* for any fixings near the ends of boards, and it is safer to use brass screws in these positions. Nails should be long and stout—at least four times the thickness of boarding, and no nail should pierce more than one layer of boarding, so that only one row of nails horizontally occurs in each board;

with this reservation, the more frequent the nailing, the better the result.

WESTERN RED CEDAR

This makes the best wrought siding —so much better than other soft woods that its use should be invariable. It is practically immune from rot or insect attack, and when left unpainted weathers quite soon to a cool grey, but it can quite properly be painted, if desired, for effect. Full particulars of commercially available types, with advice as to use, are given in a booklet, " Timber Houses and How to Build Them," issued by the British Columbia Timber Commissioner, Regent House, London, S.W.1.

A mistake made with unbelievable frequency when fixing weatherboarding over a brick or concrete base is to omit provision for the boarding extending below the framing so as to lap the base wall at least 1 in., thus protecting the plate from wet, and consequent decay.

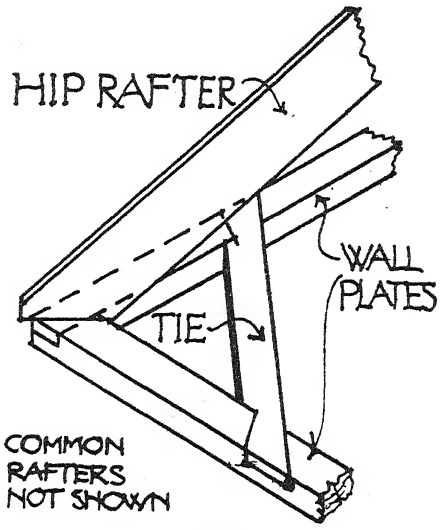


FIG. 71

SUNDRIES

A good many miscellaneous provisions of a structural nature come within the province of the carpenter, working in conjunction with other trades. He should see that the roof is securely tied, apart from such direct tie as its main design may provide. A hip roof has a tendency to flatten, which may be counteracted by the construction of dragon ties across the angles, dovetail-halved to the wall plates so that these are prevented from spreading (Fig. 71). The wall-plates of a collar roof are even more liable to push outwards on the wall-

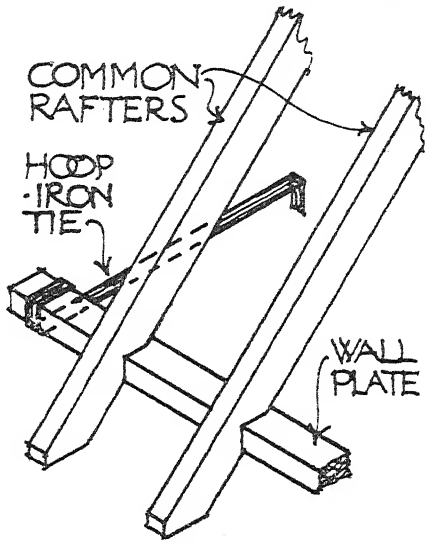


FIG. 72

head, by slight deflection of the rafters below the collar when the roof is loaded with tiles or slates. Serious movement can be prevented if at each gable-end and cross wall or partition a length of stout hoop iron is wrapped and nailed to the plate, leaving a tail of about 4 ft. to be built in by the bricklayer (Fig. 72).

POSTS AND BEAMS

Posts and beams in such positions as porches or loggias are matter for the carpenter, and in devising these features the mediæval practice before alluded to is a sound one; for instance, where two beams at right angles would meet on a corner post, adjust the latter to lie a short distance

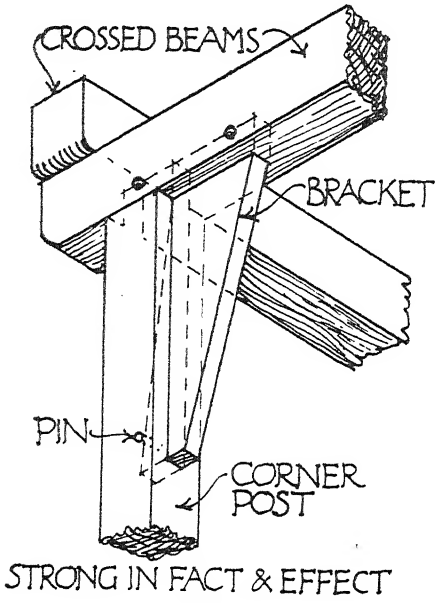


FIG. 37

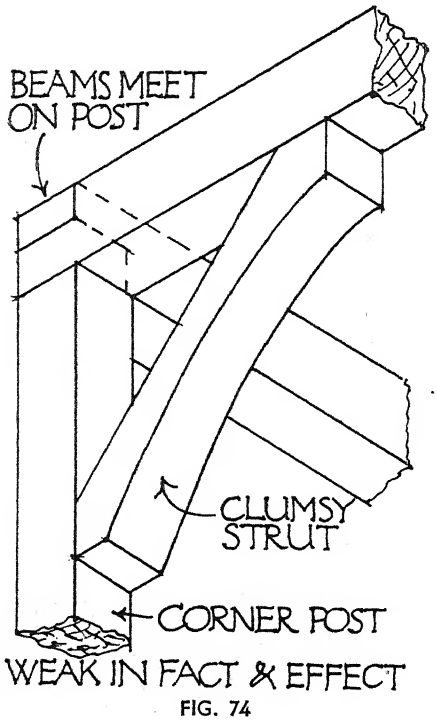


FIG. 74

inwards from the end of one of them and let the second be borne by this projecting end—cantilever fashion (Fig. 73). A suitable shaping, expressive of support, is also shown in the same sketch, as well as the logical way of introducing a bracket form where it is desired to mitigate the crudity of simple post and beam. Such brackets should be no more than one-third the thickness of post and beam, housed to both and pinned with oak as shown. The weakly curved "gallows-bracket" so often affected by builders is an offence against expression of the purpose of support (Fig. 74).

Where circumstances permit, external shelters such as porches and loggias can sometimes be contrived without either posts or beams, by continuation of the first-floor joists outward through the walls to support on their cantilevered ends a wall-plate and rafters. Such projections should not exceed half the internal span of the joists (Fig. 75).

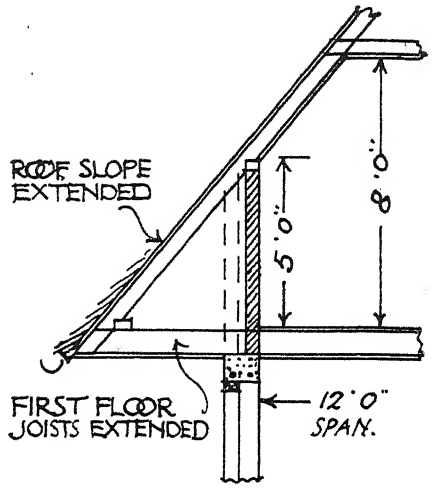


FIG. 75

TRAP DOORS

Access to roof space is increasingly given by some form of disappearing loft ladder, in conjunction with which the size and position of the ceiling-trimming becomes of importance. The special designs of different makers have varying requirements, but, generally, care should be taken that there exists no avoidable obstacle to the passage of the rising ladder to

its position of rest, and also that the foot of the ladder, when extended, will fall in an accessible place which does not block any necessary gangway.

An ordinary trap door, unless required specially enlarged for the passage of bigger articles, is best made in such proportion that a man may negotiate it by " parallel bar " gymnastics, which involves a width not greater than 2 ft. 3 in. and a length not less than 3 ft.; 3 ft. square is an awkward shape for this purpose.

EXTERNAL GATES AND FENCES

External gates and fences, when executed by building craftsmen, often err by undue weight. The design of field gates and wicket gates such as are common in farm use should be studied. Each district appears to have its own standard, and it will be a pity if these are allowed to disappear. The field gate, with some extra provision for dog-exclusion, affords a good basis for a drive-in gate; and the wicket, or hunting gate, with similar addition, makes a good path gate. The principle upon which traditional gate design is based is one of differentiation in thickness between frame and filling, the hanging and shutting stiles being 2½ in. to 3 in. thick, and the top or " back " of similar thickness, but often tapered 2 in. in depth from hinge end onwards, and the other members (brace, rails and uprights) being approximately half the frame thickness so as to cross one another without interference (Fig. 76).

Posts, on the other hand, are too frequently skimped in size; 8 in. by 8 in. should be a minimum for a single 9 ft. gate, and 7 in. by 7 in. for a pair; 5 in. by 5 in. for a single gate of 3 ft. 6in. or 4 ft. in width. Length (involving the depth of setting) must depend to some extent on the nature of ground and filling, but on clay soils, subject to seasonal movement, the irritating habit which gateposts have of alternately widening and closing the gate space can only be certainly overcome by continuation of the posts upward, with a " head " as a distance piece, as shown in Fig. 77. By a slight expansion such a head may be made to serve the purpose of support for a suitable creeper such as wisteria or clematis.

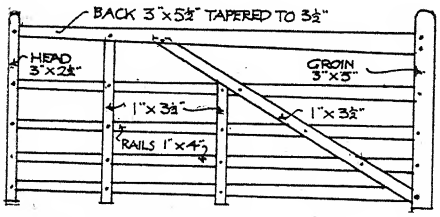


FIG. 76

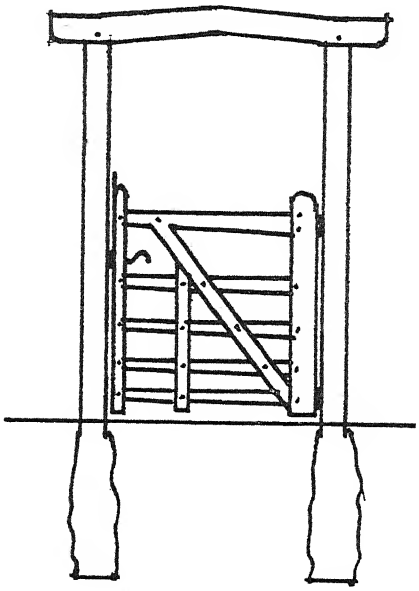


FIG. 77

The two figures show the elements of gate structure, upon which close paling or spaced slats can be superimposed as desired, and in this connection it is well to remember that in many country and suburban situations where this gate forms an incident in walling or close paling, the exclusion of *rabbits* is a desirable feature. This entails a low bottom rail or similar provision for close fitting, and careful scrutiny of spaces within reach of small animals.

Thinking of building?

Then consider the cost of comfort—that indeterminate factor which turns a house into a home.

For warmth in winter and coolness in summer there is nothing to equal TIMBER as a building material.

Look at the table below. It shows the annual cost of keeping a house warm during a normal heating season in the northern United States. The figures relate to an average-sized dwelling having an exterior wall area of 2,000 square feet.

TYPE OF WALL	Cost of Coal to Offset Heat Loss at $12 per ton
1. Standard Timber Construction—Bevel Siding, Sheathing, Paper, Studs, Wood Lath	$62.56
2. Standard Timber Construction—Shingle Exterior, Sheathing, Paper, Studs, Wood Lath and Plaster	$59.28
3. *Standard Timber Construction, timber insulated—Shingle Exterior, Furring Strips, Paper, Sheathing, Studs, Exterior Sheathing, Furring Strips, Wood Lath and Plaster	$39.12
4. Standard Timber Construction, ½″ Flexible Insulation between Studs	$41.82
5. Masonry Construction	
A—8″ Solid Common Brick Wall, Plaster on Masonry	$135.30
B—8″ Solid Face Brick Exterior, Plaster on Masonry	$135.30
C—12″ Common Brick Wall, Plaster on Masonry	$112.24
D—12″ Solid Face Brick Exterior, Plaster on Masonry	$112.24
6. A†—8″ Concrete Block, Stucco, Plaster on Masonry	$119.72
B†—12″ Concrete Block, Stucco, Plaster on Masonry	$94.50
7. A†—8″ Concrete, Stucco, Plaster on Masonry	$142.44
B†—12″ Concrete, Stucco, Plaster on Masonry	$117.72

Insulating values for most of the wall types are taken from "House Insulation," published by the National Committee on Wood Utilization, U.S. Department of Commerce, October, 1931.

* Based on insulating values published by the National Bureau of Standards.

† Based on insulating values published in the American Society of Heating and Ventilating Engineers Guide for 1931.

From the above figures it will be seen that timber possesses a far higher insulation value than any other structural material. The ideal wood for timber construction is British Columbia WESTERN RED CEDAR. For full particulars as to its properties, or for information regarding any other British Columbia timber—DOUGLAS FIR (Columbian Pine), WESTERN HEMLOCK, SITKA SPRUCE, WESTERN WHITE PINE—write :

BRITISH COLUMBIA
TIMBER COMMISSIONER

BRITISH COLUMBIA HOUSE, 1-3 REGENT STREET,
LONDON, S.W.1

Telephone : WHitehall 1814 *Telegrams :* Columbary, Piccy, London
Cables : Beeceetim, London

JOINER

GENERAL

The craft of the joiner has been revolutionised by three factors, two of which may be called internal and one external to his practice. Plywood (and its derivatives) is the first, and reaches deeply into nearly every branch of the trade; the increased complexity of fitments consequent on the standard established by expertly designed and factory-made articles (compare the " builder's dresser " of thirty years ago with the kitchen cabinet of to-day) is the second; and the third is central heating, or the continuous-burning hot water boiler. Plywood is placed first because its stable properties alone make possible the second in the presence of the third —given plywood it is no longer necessary (as it would be in its absence) to design all interior fittings with multiplicity of members to distribute the shrinkage inevitably produced by the constant drying effect of the continuous heat of " all-the-year-round " firing.

MATERIALS

The materials of the joiner are, in the main, those of the carpenter, with the addition of plywood, and with a greater variety and higher standards in the timber employed, which has to be chosen with an eye on its appearance and its ability to remain unaffected by use and contact.

Further factors thus enter into the choice of timber to be used by the joiner. It is necessary to be sure that flooring material will withstand abrasive wear, and that any joinery intended to be painted will preserve a good surface free from corrugation under working conditions, while if it is intended for stain, a pleasant grain and freedom from ugly knots are important.

Apart from these special considerations, the general question of quality has received expert attention during recent years, with a view to the establishment of standards more precise than the loose specification requirements hitherto generally current in all but the highest class of work. As a result of such attention by the B.S.I. in collaboration with the F.P.R.L., Standard Specifications for the various common components of house design which are generally factory-made are in preparation, and several have been issued.[11] The standards vary according to purpose, but the relative clauses which appear in the specification for wooden windows may be taken as generally representative. They are:

(*a*) *Freedom from defects.* — The timber used . . . shall be free from decay. It shall be sound, and the surfaces exposed to view shall be free from loose or dead knots exceeding $\frac{3}{8}$ in. in diameter. Checks not exceeding in their depth one-half of the total width or thickness of the timber shall be allowed on surfaces not exposed to view. Slight surface checks only shall be allowed on surfaces exposed to view.

(*b*) *Moisture Content.* — The moisture content of the timber shall not exceed the limits given in Table I.

The test for moisture-content is made as described under " Carpenter."

(*c*) *Sapwood.* — Sapwood shall be permissible in softwoods only, and shall not exceed 15 per cent. when measured as a percentage of the

11 B.S.S.459, Doors; 644, Windows, 645, Cupboards and Dressers; 584, Mouldings; 583, Gates; 585, Stairs.

TABLE I MOISTURE CONTENT LIMITS

Description of Material.	Hardwoods (excepting cills) Max. per cent.	Softwoods Max per cent.
Solid frames of casement and frame windows	23½	22
Materials other than above	18	16½
Materials for centrally heated buildings (to be stated in inquiry or order)	12 per cent.	

superficial area of any cross section of the timber.

It should be remembered that these standards are *minimum* ones throughout, and represent the most upon which it is thought possible to insist as a mean course between the desirable and economically the most often available. For internal joinery, a moisture-content under 12 per cent. and a proportion of sapwood not over 10 per cent. would be reasonable stipulations in ordinary good quality work, and should be attainable.

The use of woods other than deal and oak.—The properties of deal (Northern pine) and of European oak are well known by familiarity. Teak and pitchpine are also sufficiently long-established for their behaviour to be understood. Some of the more recently introduced and popular timbers are not yet free from uncertainty in use. The variety of timbers now on the market originating in tropical or Antipodean forests is now so remarkable that it is impracticable to deal with all—in fact, very little is known as to the ultimate performance of many of them, but there are a few species now in frequent use, about which it may be useful to present some notes.

British Columbian or Oregon Pine (Douglas Fir).—This has made the greatest headway of any recently imported timber, consequent on its large growth and freedom from knots and sapwood, which can be absolute. It suffers, however, from three qualities (not strictly defects) which unfit it for indiscriminate use.

(1) Its shrinkage, if insufficiently seasoned, is excessive.

(2) Unless carefully selected it shows wide variety in the texture and scale of its grain, which can be unpleasantly bold and staring.

(3) It is apt to exude resin in a way detrimental to stain and fatal to paint; in fact, it is seldom wholly satisfactory for painting when new, owing to corrugation which arises from its rather coarse grain. It is perhaps noteworthy that imported stock doors of this timber are frequently found superior in performance to shop-made doors where every effort is given to the production of sound work—presumably the greater length of seasoning accounts for this.

Western hemlock, also of North American origin, shows some likeness to Douglas fir, but has a more even grain, is a suitable joinery timber, and when quarter sawn makes admirable flooring.

American whitewood or "canary-wood."—This has a beautiful silky grain without strong markings, looks well, and tones by exposure to light to a lovely brownish mauve if used "in the white," and it also takes either stain or paint. It is available in wide boards, which, however, are liable to shrink and twist considerably, and its surface is rather subject to bruising or denting, so that it is unwise to employ it where heavy use is likely.

Western red cedar, already referred to under shingling, is suitable, from

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Western red cedar, already referred to under shingling, is suitable, from

its exceptional durability, for all exterior joinery and for ground floor joists, plates, and sub-flooring. It can be left untreated, but will take and retain paint or waxing quite readily. Its hygrometric qualities are low, so that in use it expands and shrinks less than most softwoods with change in atmosphere, but it is not suitable for floor boards, because under wear it develops a "stringy" grain, and if used for joists or weight-carrying purposes either the customary span must be reduced or sections increased to compensate for its lesser strength and stiffness.

GROUND FLOOR BOARDING

Ground floor boarding, laid on joists which must be efficiently ventilated beneath, should always be grooved and tongued, and preferably secret-nailed. It is also advisable that it should be laid in narrow boards, say, not over 3½ in. on face, to minimise the width of the joints after shrinkage. The direction of the boarding is also important in relation to the source of light and shape of room. If lighting is from one source, the joints should run towards it; if across, the slight natural curling of the individual boards will be made very apparent. If this consideration does not outweigh it, the best direction for floor-boards is with the length of a room, which tends to emphasise dimensions. It is best to support the lower floor, independently of the walls and partitions, on sleeper walls, and it is both unnecessary and unwise to build these in close contact with outer walls where they run parallel, or to cut the joists so as to touch the walls (see Fig. 14). If spacing of sleepers in relation to bearing of joists is aided thereby, the end sleeper-walls can safely be built up to 1 ft. 6 in. distant from the outer wall and joist-ends, leaving the margin of the floor cantilevered (Fig. 78, where (*a*) will give a stiffer floor than (*b*)).

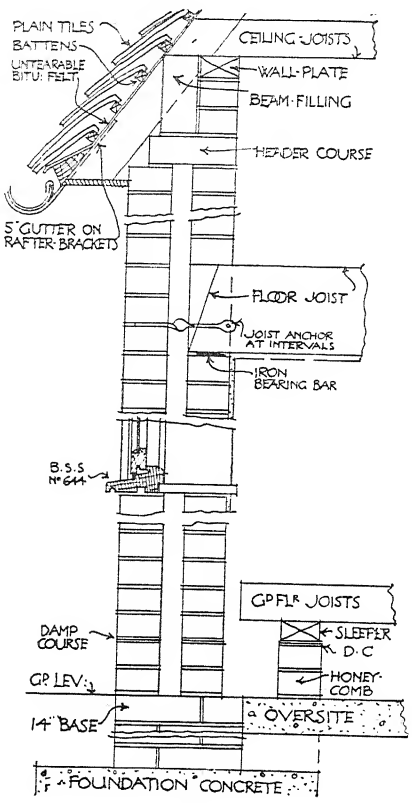


FIG. 14

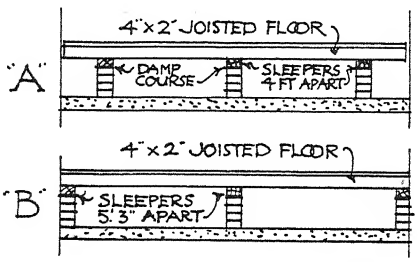


FIG. 78

SOLID FLOORS

Solid floors covered by boarding are a frequent source of trouble from one or other form of decay. From investigations made by the F.P.R.L. it appears that two systems can be safely employed. These are:—

(*a*) The boards may be nailed to a layer of breeze concrete (or to breeze fixing-blocks let into concrete) which has been covered with a damp-proof course consisting of a continuous layer of bitumen, poured hot, having a minimum thickness of $\frac{3}{8}$ in. in any place, not less than 10 lb. per square yard being used. The underside of the floor boards should be treated by brush application of a wood preservative.

(*b*) The boards may be nailed to wooden fixing fillets, preservatively treated, let into the concrete, the whole covered as above with bitumen, and the underside of boards brush-coated similarly (Fig. 79).[12] Small sealed air-spaces beneath boarded floors in contiguity to concrete laid on earth filling appear to be dangerous—space should be either capable of ventilation or non-existent.

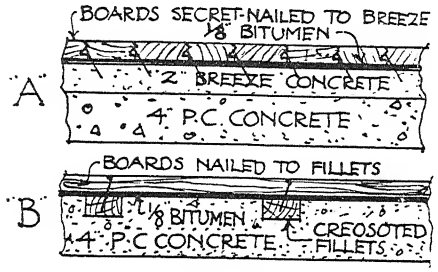


FIG. 79

UPPER FLOOR BOARDING

This, which is less commonly ventilated, need not so necessarily be grooved and tongued, and it is indeed sometimes found an advantage that it should be square-edged, so that it may be lifted when required for access to pipes or conduits without butchery. If it is grooved and tongued, which does something to restrain excessive curling, screwed boards should be arranged above pipe-runs which may need access, though this is nearly impossible where the directions cross.

12 F.P.R. Records, No. 14. Dry-rot Investigations in an Experimental House, 6d. net.

SHRINKAGE OF FLOORS

From the combined shrinkage of joists, boards and skirtings (the latter fixed to *walls*) there is usually about $\frac{1}{4}$ in. gap between the floor and skirting after a few months, and in most situations draughts issue most uncomfortably therefrom. This should be countered by the fixing of a quadrant fillet *nailed to the floor* as in Fig. 80, which is free to move without reopening the unwelcome draught-slit.

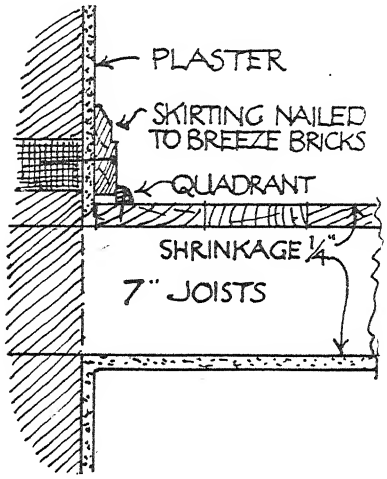


FIG. 80

WOOD BLOCK FLOORS

These seldom rot if they are carefully protected against moisture rising from the soil. They should be fixed and laid on a layer of waterproof mastic or bitumen which is thick enough to prevent them coming into contact at any point with their concrete base. Such floors, however, not uncommonly lift from their bed, sometimes rising in a shallow dome, which severs connection with mastic or screeding, and is liable to fracture and collapse under traffic. The primary cause of such behaviour is usually the omission of space for expansion next walls, which leads to the

(probably kiln-dried) blocks absorbing moisture from the damp air of a new building and "arching" from expansion or swelling until pressure raises them off their bed. In the moderate sized rooms of a house sufficient space can be left beneath the skirting to obviate this failing, but in larger rooms or halls one of the patented types of flooring having direct fixing at intervals to plugs in the concrete is advisable. The force generated by swelling is so considerable that it is important that the screed to which the mastic and blocks should adhere should be of good quality; otherwise the blocks may rise, bringing portions of the surface with them.[13]

As well as the priming coat of bitumen applied to the screeding, each block as laid should be dipped in hot mastic and tapped into place with a *slight* sliding motion. B.R.S. Questions and Answers, 2nd Series, No. 88, gives full advice as to suggested best procedure in laying wood block floors, which may be summarised as follows:—

(1) Best adhesion will be obtained if after first dipping blocks are skimmed and redipped and placed directly into position without undue sliding.

(2) A portion of the adhesive thinned down, or a black varnish, make the best primers for the concrete base.

(3) Temperature for molten coal-tar pitch should be about 120 deg. C. (248 deg. F.); for bitumen 150 deg. C. (312 deg. F.).

(4) Softening point of mastic should be 30-40 deg. C. (86-104 deg. F.) for coal-tar pitch, up to 45 deg. C. (113 deg. F.) for bitumen, the aim being workability at heating temperature without brittleness when at normal temperature.

SUBFLOORS AND SUPERFLOORS

The American practice of laying a rough sub-floor, which can be freely used as a working platform without the need for protection, and subsequently covered with a surface of quality material, is one which is so eminently sensible that it might be more often adopted here. Practically the only superfloors of which we seem to be aware are lino and parquet. Suitably surfaced plywood in squares, or strip flooring grooved and tongued on ends as well as sides are excellent alternatives. Such floorings are preferably laid after the skirtings are fixed, and before the quadrant fillet shown in Fig. 80. A caution is necessary in the case of boards (strip or otherwise) laid over boards. If the direction of joints is the same in under and upper floors, coincidence may cause some of the joints to rise so as to form unpleasantly prominent ridges. This may mean reversal of joists so that the floorings may be at right-angles while the visible joints run "from the light" as mentioned previously, but if this is inconvenient (for reasons of span) the lower or subflooring can be laid diagonally at 45 deg. to joists and superflooring alike, the latter remaining at right angles to the joists as usual.

WALL LININGS

Accessories to the resources available for the internal finish of house walls are the numerous types of insulating wallboard and plywood which have supplemented the one-time invariable plastered surface. The important conclusions of B.R.S. as to the more rapid attainment of comfortable room temperatures when walls are lined with wood, as compared with plaster or brickwork, compel attention to this practice in the case of rooms relying mainly on *intermittent* forms of heating, such as gas or electric stoves. The circumstances attendant on domestic heating should be

[13] B.R.S. Questions and Answers, 3rd Series, No. 236.

more clearly understood. Where complete or proportionally high continuity of heating is attained (as with efficient central-heating plant, anthracite or similar closed types of stove, or the open fire burning throughout the day) an appreciable amount of warmth is absorbed by walls, floors, ceilings and furniture, to be re-radiated upon the room's occupants. In the case of occasional heating appliances, active only while rooms are in use, walls remain cold, and tend to rob the human body of its heat, instead of preserving the balance, or even contributing something to the preservation of comfortable temperature. It is in such circumstances that a wall-lining of less conductive material can benefit the users. In the case of an experimental trial reported by B.R.S.[14] it was found that plywood panelling secured a pleasant temperature in one-third of the time which had been required under similar conditions with walls of plastered finish.

WOOD FIBRE BOARDS

Wood-fibre boards used in this way on brick or other solid walling are most usually applied to battens secured to the walls at intervals which will coincide with the uncut width of the board selected, with intermediate fixings varying according to need, but preferably not much over a foot apart. There are two troublesome matters to be surmounted in this connection: (1) the actual fixing of the boards, and (2) the finish of their joints. These are inter-related. In our humid atmosphere it is not abnormal to find that fibre-boards expand and contract appreciably between summer and winter conditions, which usually means that butt joints which would be close in winter are open in summer, and with some of the thinner boards may even mean that edge-fixings tend to tear loose under stress of shrinkage. For these reasons a method of fixing which will leave the edges free to move, and allow a slight open space between them is practically desirable. On ceilings there seems no objection to a treatment which widens and boldly exhibits the open joint, lining behind it with a strip

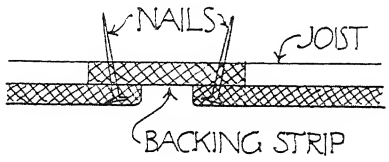


FIG. 81

of similar material (Fig. 81), but on wall-linings some form of cover-strip seems generally desirable, and this is most conveniently of wood. By fixing the wood cover-strips so that they hold the edges of the fibre-boards

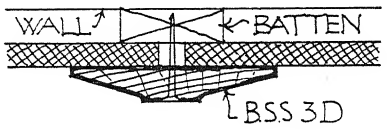


FIG. 82

unnailed (Fig. 82) these are given increased freedom. In small rooms, where no horizontal dimension between angles or openings exceeds 14 ft., it is possible to scheme the linings so that no vertical joints occur except at corners. In such a case skirting, chair-rail and cornice or picture-rail can cover all joints (Fig. 83).

There remain the intermediate fixings, which it will be generally desired should be inconspicuous, though it might be argued on the score of truth that they should be exhibited and made the occasion for added effect—as in the case of the chromium-headed screw studs used with glazed sheeting. There is a form of double-pronged nail which is claimed to give a secret fixing to wallboards, but its use requires great care and skill, and

14 B.R.S. Annual Report for 1931.

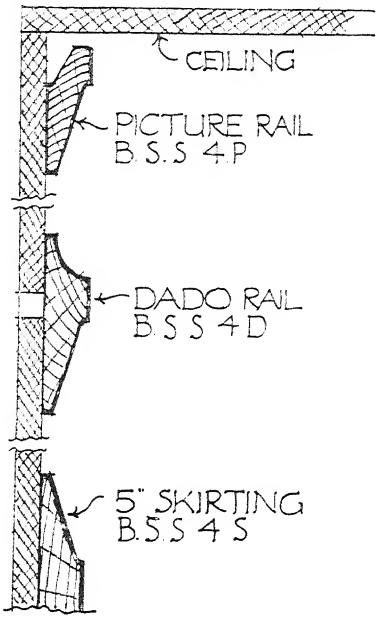


FIG. 83

entails occasional undiscovered failure when a point bends unluckily. On the whole it is best to use large-headed nails, punching the heads well in and making good with hard stopping, which should be roughened to suit the texture of the board.

PLYWOOD LININGS

Those which are not applied (rather mistakenly) in the form of simulated panelling, present somewhat similar problems, but have the advantage of inviting cover-strips of similar timber, which may either cover each line of fixings, or only actual junctions of sheets; in the latter case the problem of intermediate fixings recurs. With care this problem may be surmounted by prising up a series of slivers of the surface with a sharp tool, nailing through the exposed base, and subsequently glueing and pressing down the raised slivers, which, when again firmly set, may be smoothed with scraper and polisher—but this is a delicate operation.

SKIRTINGS, CORNICES, PICTURE AND DADO RAILS

It is, no doubt, a rudimentary fact, but one often forgotten, that each of these horizontal members has a definite practical purpose, and fails in fitness if it does not achieve that end. A wood skirting is not only a base to the wall, but should protect the surface above from casual contact by movable furniture, and should itself admit a certain amount of knocks and grazes without suffering visible damage. Brooms and vacuum cleaners are apt to mark the lower face of any tender or delicately-coloured skirting, and it is a useful practice to recognise this, at least in such rooms as kitchens or workrooms, by colouring the bottom flat about 3 in. high black or some similarly obscuring colour. In ordinary usage the skirting should be about $\frac{1}{8}$ in. less in thickness than architraves, so as to be neatly stopped thereby. Happily, the Victorian custom of graduating the height of skirting to the assumed importance of rooms has fallen into disuse—skirtings are no longer 11 in. high and double-faced in the drawing-room, and 7 in. in the kitchen! B.S.S. 584, dealing with mouldings, gives excellent stock sections of architrave, dado rails, picture rails and skirting designed to be used together and to intersect where it is convenient for that to happen.

Wood cornices are now rarely employed, but may be used with advantage when walls are lined with fibre-board or plywood.

PICTURE RAILS

Picture rails suffer in esteem from their name, which suggests solely a rail over which picture-hooks may be hung. They suffer still further from common practice of painting or staining them with relevance to the interior woodwork, rather than as part of the wall surface, resulting only too

often in their obtrusive appearance as a streak of discordant colour out of harmony with adjoining tints. A picture rail relatively flat in form and deeper than is usual serves an admirable purpose as a capping to wall treatment, dividing it from the ceiling treatment, in which application it can be placed either in line with door architraves or immediately beneath the ceiling. Such a rail, coloured as part of the wall independently of other joinery, can be used with good effect to influence the apparent proportion of rooms. A point which requires careful study in each separate case is the placing of the picture rail in rooms partly in the roof. A very fidgety effect is attained when this member either dies out feebly against sloping soffits, or jogs up and down as the vertical enclosure formed by walls or partitions rises or falls in height. The best effect is perhaps reached by selection of a level (even if only 5 ft. from the floor) at which the " picture rail " can run continuously as to height.

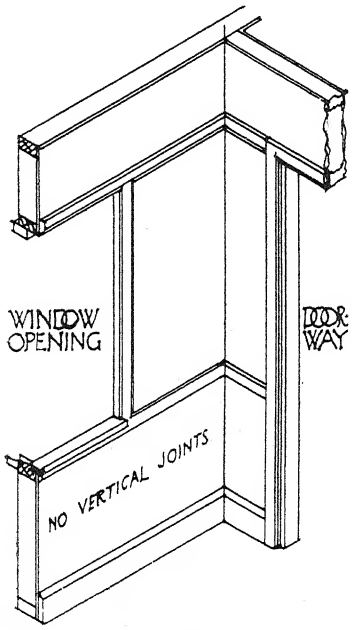


FIG. 83a

DADO RAILS

Dado rails have as their function the reception of knocks from chair-backs, and sometimes the formation of a neat finish to a darker colour or more resistant surface for the lower wallface more subject to rough usage. They are less commonly introduced than once was the case, but have their uses in such circumstances as described and shown by Fig. 83a, and also might often be used with advantage in kitchens and small dining-rooms, where their presence can reduce the need for frequent redecoration.

CASEMENTS, FANLIGHTS, ETC.

A vast number of houses which are built to satisfy the needs of the people who buy or rent, and not a few of those " built to order," would be saved from that appearance of haphazard muddle which so often distinguishes their outward form by the simple device of employing a standard glazing unit and taking some care so that window-heads line up. There is often reason why cills should vary in height above floor-level—a window for prospect may need to be brought within about 1 ft. 6 in. from the floor (to permit outlook by the occupants of lounge chairs), while one behind a sink must be 3 ft. up or over; but there is no imperative reason why window-heads should jump up and down. Their height is regulated by average human stature, and with storeys of the bye-law domestic height of 8 ft., should not generally be below 6 ft. 6 in. for outlook or above 7 ft. for structure.

The issue by B.S.I. of Standard Specification No. 644 giving details of both casement and sash windows alike based on a pane proportion of $10\frac{3}{4}$ in. by $7\frac{3}{4}$ in. ought to assist in procuring a less irregular system of fenestration in the average small house dependent for its joinery on

stock productions. A criticism must, however, be lodged against the omission in this specification of reference numbers to the various types, which prevent them from being as easily identified as in the case of several standard metal windows, which it is convenient to mark on drawings with certainty that the intended type will be supplied. If this omission were rectified use of the types would be greatly facilitated.

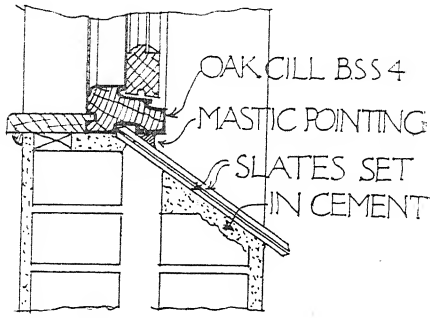


FIG. 84

EXPOSED POSITIONS

The detailed sectional design of casements and their frames, as shown in the drawings attached to the specification, does not aim higher than a decent average for normal use, not too far in advance of everyday practice. The growing habit of selecting very exposed situations for building houses makes it necessary in many cases to adopt sections having additional measures designed to check penetration of wind-driven rain, either at the joints between casement and frame, above the cill, or at that most vulnerable point, the breast wall beneath the cill itself. As regards the latter point, it is advisable that one of two courses should be followed. (*a*) When frames are set flush with outer wall face the oak cill, sunk, weathered and efficiently throated, should project sufficiently far in advance of the frame and breast wall to throw the considerable amount of rain, which streams down the non-absorbent glazing, well clear of the wall; (*b*) frames set in reveals must have an impermeable cill formed beneath the wood cill—otherwise soakage will be most certain to appear. Brick, tile and cement weatherings often fail in this position. Sawn slate or roofing slates doubled and set breaking joint in cement at a good inclination (Fig. 84) are effective.

As to the design of casements themselves, it ought to be generally recognised that a tight joint cannot be made by edge-fit; not only is the attempt bound to fail, but it results in windows "binding," with the consequence that they must then be eased. The formation of cavities sufficient to interrupt the capillary path and prevent water being held between opposing surfaces is the surest way of excluding driven rain, the closing of the casement against the back of the rebate on the frame being relied upon for draught-exclusion. There are now several specialist designs for watertight casements which embody a front overlap as well as the rear rebate, and include effectual groovings. These types can be had from firms in most parts of the country. Other types not subject to patent or licence restrictions can also be devised (Fig. 85).

CILLS AND TRANSOMES

Other points which should be observed are: (1) Cills should always be of oak or teak, and by sunk weathering should ensure that water streaming from the window is opposed by a check so that it cannot be forced beneath the bottom rail. (2) Hopper-lights when desired do not necessitate a solid transome which repeats the weakness of the cill, and with its adjacent casement top and bottom rails must obstruct about 5½ in. depth approximately at eye-

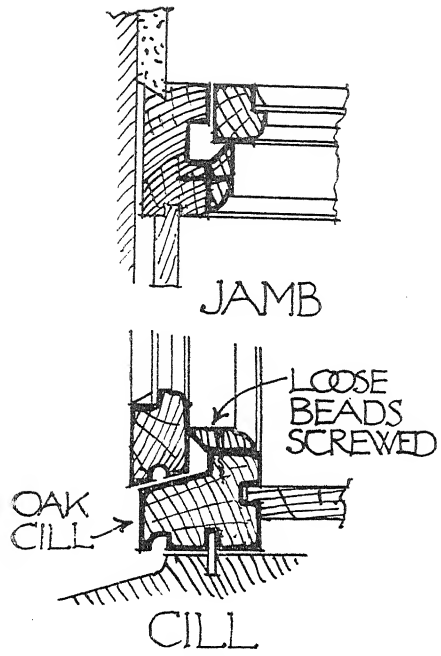


FIG. 85

level. The "mock transome" or deep bar (shown in B.S.S. Plate 2, No. 10) reduces the obstruction to 3½ in. and need only be divided in the actual lights which are required to open (Fig. 86).

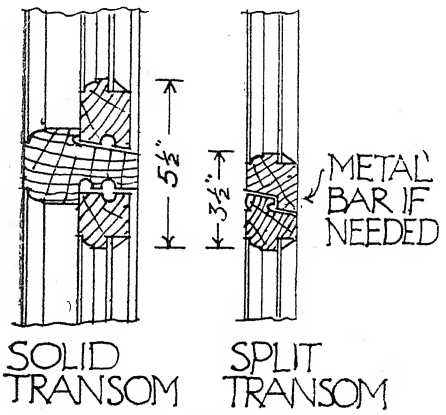


FIG. 86

The value of eaves-projection to exclude rain from drifting so readily into open casements has already been mentioned under "Carpenter," and several minor points as to the fixing of frames under "Bricklayer." Ironmongery or hardware will be discussed at the conclusion of this trade, but it may perhaps be said here that probably one of the factors which has popularised standard metal casements is their complete equipment with suitable hinges, fastenings and stays, without further trouble in selection and fitting. Joinery manufacturers have been slow to respond to this circumstance.

DOUBLE-HUNG SASHES AND CASED FRAMES

B.S.S. No. 644 also covers lifting sashes on the same proportional basis as casements, and this is beneficial since it is often convenient in small houses to use both types of window. There are several reasons for this; the principal ones are: (1) Places such as larders, w.c.s, etc., do not in general require windows of the size and complication which the smallest practicable sash produces. (2) The desirable lowness of cill and height of head, and the fact that the latter will not in ground floor rooms usually be protected by an eaves, makes the tall sash window a convenient form for living-rooms, but less convenient for upper floor bedrooms where the cill is usually higher and equivalent glass area can only be obtained by increase in width. (3) The best of sashes will rattle severely during gusty winds, making casements preferred by many people for bedroom windows. Many of the L.C.C. housing estates show excellent treatments of casements above combined with sashes below.

WIDE SASHES

Sliding sashes of one, two, three and four panes in width can usually be relied upon to move fairly easily,

though the four-pane sashes are rather prone to jam when either sash is less than three panes high. When wider windows are desired, however, multiple sashes become obligatory, and a common practice is to double sashes about a centre mullion. This has most objectionable effects. Almost everyone feels a natural desire that the middle of a window should be unobstructed, but in such a case the boxed frame accommodating two sets of weights and the adjacent sash stiles together form a central obstruction of about 8 in. in width. For this reason the type sometimes called the " Venetian " frame is to be preferred for effect both inside and out, and has been adopted in B.S.S. 644. In this type the centre sash alone is hung and slides between solid mullions 2 in. in thickness, the pulley lines being carried in the boxed head above the tops of the fixed sidelights so that the weights travel in the cased outer frames. Windows of this type (Fig. 87) have a much less clumsy appearance than the alternative of coupled sashes.

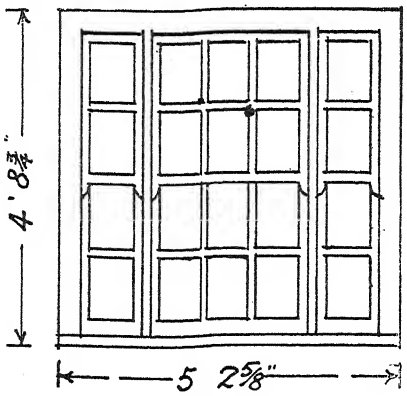


FIG. 87

MISCELLANEOUS DETAILS OF SASH-WINDOW DESIGN

The provisions of B.S.S. 644 cover the desirable minimum in the way of substance and fitting—grooving, tongues, weathering, and the like. More substance in the pulley-stiles and a greater depth in internal window-bead are beneficial when the utmost economy is not essential. The deep bead at the cill which permits the bottom sash to be raised a trifle, so as to secure ventilation at the meeting rails, is also a desirable thing. Observation shows that decay most frequently begins at the junction of outside lining and cill, owing to the water-holding nature of this joint. By cutting back the lining as shown in Fig. 88, risk of decay is much reduced.

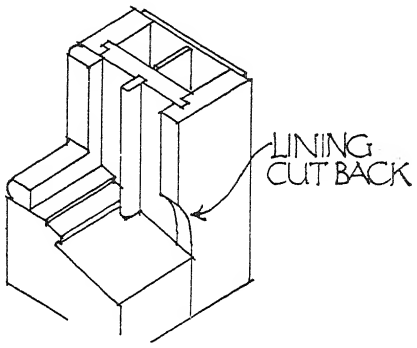


FIG. 88

DOORS

House doors are of three main sorts—external doors, room doors, and garage doors; these may be subdivided into three structural types—ledged doors, panelled doors, and flush doors—the former nearly extinct and the last-named enjoying a popularity which should perhaps be restrained by discretion.

EXTERNAL DOORS

The main entrance door of the average modern house seems usually one of the least satisfactory features of its design. Commonly it is " fussed up " and over-designed, and not infrequently it displays a pinched proportion expressive of anything rather than welcome. Practically, also, it is only too often subject to penetration

between door and threshold by driving rain, and liable to admit burglarious entry with the minimum of trouble and exertion. Let us consider these failings in order:—

(1) In place of the over-designed entrance door, there are many advantages in a simple type of door common among old cottages and immensely practical in use. This is the type whose external face consists of three or five wide boards, their vertical joints covered with chamfered or moulded fillets, which die out at the base on a projecting weather mould. Such a door may be inexpensively prepared either by applying the boarded face to a door of the same general type as the room doors, or the face may be applied to a skeleton braced frame, lined internally with plywood. It admits the use of oak boards and fillets for the external face without calling for an oak door, and a glazed aperture may be readily included if it seems advisable, by framing such an opening in similar horizontal fillets to those which cover the vertical joints (Fig. 89).

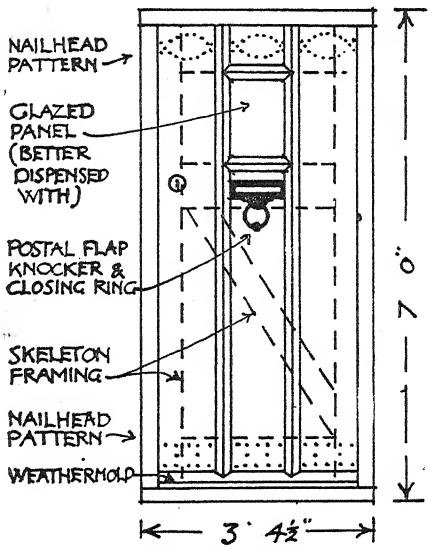


FIG. 89

If the cover-boarding is to be painted, added interest may be given by bands of nail-heads set out in geometrical patterns. For this purpose ordinary hob-nails serve well, and fixing is facilitated if the pattern is set out in pencil on the primed door-face and the position of each nail defined by a bradawl-hole. The door can then be painted up to its penultimate coat, after which the nails are inserted and covered by the final coat.

If flush-facing seems appropriate (which must depend on general design), metal-faced plywood is the most reliable substance. Care should be taken that the edges are sealed, and exact fit is necessary owing to the virtual impossibility of adjustment by ordinary means.

(2) In no case should an entrance door, even to the smallest cottage, be under 3 ft. in width. For the average small house an overall dimension for the frame of 3 ft. 4½ in. in width by 7 ft. in height seems proportionate.

(3) In the exposed situations in which modern houses (seeking outlook) are frequently placed, there is no more difficult point to make weatherproof than the bottom edge of the entrance door. If this can be planned with the benefit of a deep porch the problem solves itself, but when open to wind and rain a complete solution is nearly impossible. Any elaborate system of waterbar on the cill or threshold seems inadmissible at a general entrance, and though it is possible to devise a projecting weather-mould which theoretically should throw off rain running down the door face, in practice this preventive is apt to fail under stress by wind-driven water concentrating at whichever end of the mould the set of the wind impels it; obviously the projection must cease at either end. Protection by an effective porch is the best specific; failing that, the best use must be made of (*a*) a weather-mould; (*b*) a wood threshold and waterbar; a waterbar is less likely to trip people

if incorporated in a visible obstacle such as a raised threshold than if grooved into a flush brick or stone step, and the threshold, moreover, serves to raise the door so that it will pass a mat; (*c*) a drop in level immediately beneath the door, so that water dripping from the weather-board cannot be blown under. A great deal of additional risk is invited when an external step projects *at the same level* as the floor inside the doorway, catching and holding the water from the door-face (Fig. 90).

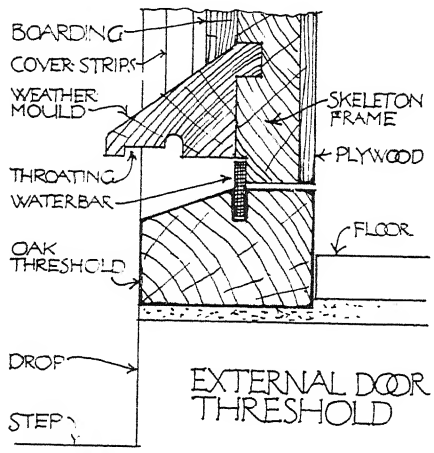


FIG. 90

(4) The temptation to burglarious entry which is afforded by the common juxtaposition of a glazed panel and a night-latch, engenders wonder that housebreaking is not more frequent. Another detail which does not conduce to security is the prevalent reliance on the holding-power of wood-screws in latch and striker against forcible entry. A form of latch in which the face-plates both of latch and striker are prolonged over the edge of door and rebate of frame (with screw fixings) makes forcing less easy. The use of mortice rack-bolts (not, unfortunately, in action when the house is vacant) tends to strengthen resistance still further, without the internal disfigurement caused by the clumsy appearance of neckbolts and similar alternatives.

BACK DOORS

Somewhat similar considerations apply also to the back, side or "trades" door, and like precautions may be employed. Sufficient external cover over this door will cause the delivery of goods to be less uncomfortable both for tradesmen and recipient. A practice which is apt to be much appreciated is the division of the door into two heights—stable fashion—allowing the top half to be kept open, in suitable conditions, for light and air without complete exposure of the house interior. It should not, of course, be forgotten that this practice entails four butt hinges and at least one additional door-bolt. Anyone proposing to adopt the device should have the door framed as one, with a deep middle rail, 4 ft. up to its centre, suitable for division.

FRENCH WINDOWS

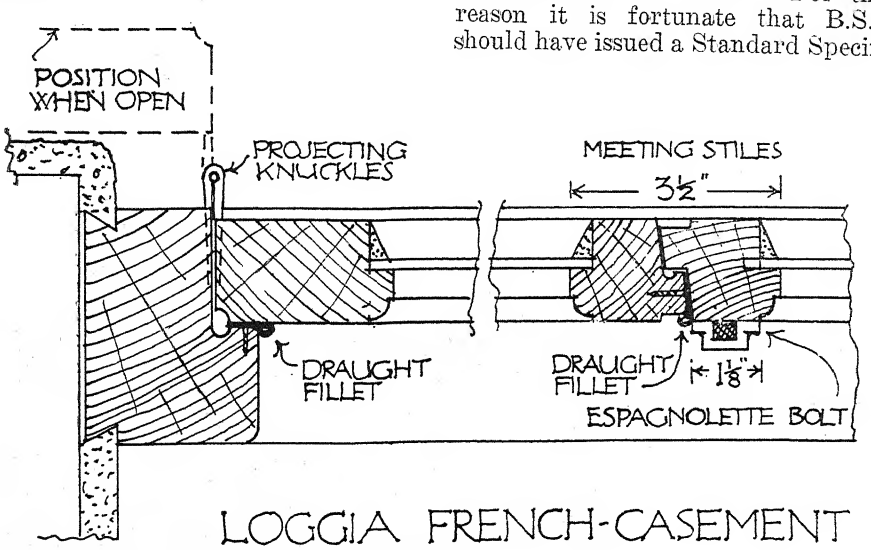
These are a provision which few modern houses lack. They permit direct egress from rooms to garden (often by the medium of a loggia or sun-porch), and when open may bring the room itself into closer relation with the outside world. Against these advantages must be set the undeniable facts that they may be subject to most of the practical drawbacks of other external doors, and are notoriously cold and draughty. The trifling amount of alternate swelling and shrinkage of wood frames is sufficient to defeat any attempt to minimise the draughts by close fit; and a design which should keep out keen east winds must embody provision for rubber or metal draught fillets to make positive contact when the leaves are closed. Conditions are also improved if the glass area is not too close to floor level; it is not always appreciated that a good deal of the apparent draught from windows in really cold weather comes, not through crevices,

but by convection currents of air chilled by the cold glass surfaces in contact with the outer air.

Other points relative to French casements are:—(1) Care should be taken to ensure that the leaves when open will lie flat against a wall. This involves use of sufficiently large butts to allow the knuckles to project by at least half the thickness of the doors. Many a loggia is rendered practically unusable by the obstruction of the doors when open! (2) A type of fastening should be chosen which does not expose the knuckles of the user to risk of skinning each time the doors are opened; a lever-actuated espagnolette bolt (Gibbon's "Wedgetite" is very satisfactory) rather than any form of rotating handle is safe in this respect. Fixing requires a width of only 1⅛ in., which enables meeting stiles of a total obscuration of 3½ in. to be used; often a needless mass of wood framing is seen at this central point, with the same unhappy effect as described in reference to coupled sashes (Fig. 91).

ROOM DOORS

The first necessity for a door giving access to a room is that it shall be capable of admitting the largest object which it is desirable should be introduced. In rooms which require furnishing this will probably be some big piece of furniture such as a piano, settee, or wardrobe; in rooms which are unfurnished (e.g., larders, w.c.s, or bathrooms) it will be the biggest person likely to enter. Unnecessary width in a door curtails the usable space in a room; for this reason it has been customary to vary the width of doors. This is recognised in the manufacture of "stock doors," where, however, it has been unfortunately customary to vary the *height* inch for inch with the width, a 2-ft. door being 6 ft. high, a 2 ft. 6 in. door 6 ft. 6 in. high, and so forth. This custom has had no discoverable reason and has produced manifest inconvenience, since where a 2 ft. door would prove sufficient, its height of 6 ft. might be less than enough, while wherever doors of varying need (and width) occurred adjacent to one another—as often on first-floor landings —their variation in height would have a fidgety effect. This aspect of the joiner's trade became of increasing importance with the fashion for flush doors, which from their inward complication are necessarily factory made and tend to be "stock." For this reason it is fortunate that B.S.I. should have issued a Standard Specifi-



LOGGIA FRENCH-CASEMENT

FIG. 91

cation of door sizes[15] in which 6 ft. 6 in. is adopted as a standard height for interior doors, irrespective of width, with the addition of a 6-ft. type in the narrowest width, which is suitable for cupboard doors whose lower edge overrides the skirting while the top level can finish at the same height as adjacent room doors.

After the settlement of suitable sizes, the next consideration as to doors is their design and construction. This is less a matter of visual choice than formerly, since by the introduction of central heating, and even by the less drastic provision of continuous burning stoves and hot-water boilers, doors and similar framings are subjected to conditions which they very seldom had to face in the past. The aggregate shrinkage which can occur in woodwork, between the moist condition of a new or unoccupied building and the desiccated condition of a continuously warmed one, impels special consideration to minimise its effects. Two lines of approach are open; a door can be made up of so many small units that the individual shrinkage of any one of them is almost negligible, or it can be faced with a single unit of a material in which the tendency to shrinkage is countered. The former method is the nine-panelled door, and the latter the flush door faced with plywood. Each has its suitability on occasion, and its attendant drawbacks.

PANELLED DOORS

The small-panelled door (Fig. 92) utilises the original function of panelled construction for its original purpose—the equalisation of movements. In design it is apt to look clumsy if the intermediate rails and muntins within the marginal frames are not reduced to relatively narrow widths. In construction the object of the design may be frustrated if the muntins are merely scribed over the rails and not genuinely mortised or dowelled as well. Instances have occurred where (when shrinkage was at its maximum) both panels and muntins could be worked along to right or left until daylight became visible between end-stile and panel at the opposite end!

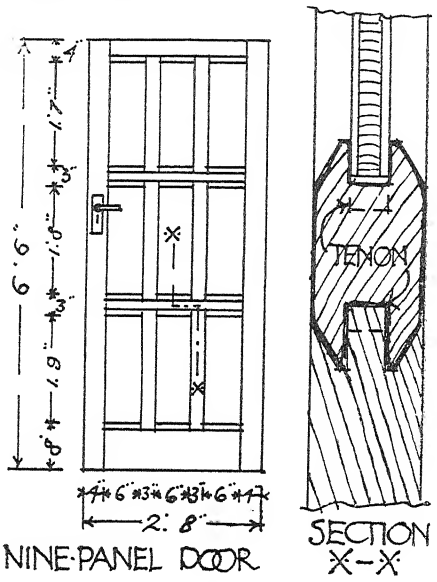


FIG. 92

With this type of door the fixing of an ordinary mortice lock will present some difficulties, since a wide lock rail is not easily incorporated. An upright mortice lock, or "sash lock," with lever furniture, is, however, quite suitable, and the lever type of handle offers further advantage in that it does not create the danger of knuckle-grazing which a knob-handle would do in position so close to the shutting edge of the door. In detail, such doors look best if the rails are splayed and the stiles and muntins square-edged; the latter may, however, be face-moulded, where that treatment seems suitable, with pleasant effect, the shallow sinkings dying out on the rails.

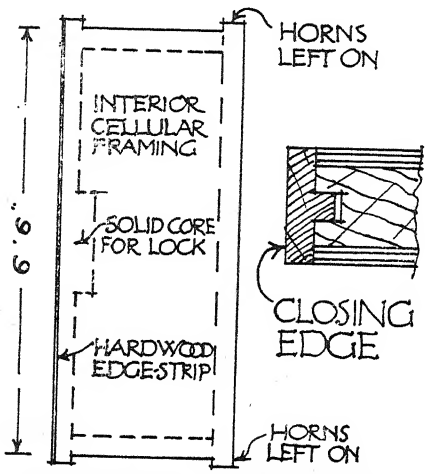
More orthodox designs of panelled doors having one, two or four panels, are still possible in houses not too fiercely heated, the use of plywood for

15 B.S.S. No. 459. Doors (Morticed, Dowelled, and Ledged and Braced).

panels minimising the effects of shrinkage. The material and construction of such doors is covered by the B.S.S. before cited.

FLUSH DOORS

Outwardly, the flush door is a simple thing, but its internal structure is often far more complex than any comparable predecessor. Its plane face (" no corners for dirt ") endears it to the keen housewife, though a word may be, perhaps, said against its indiscriminate use in all possible circumstances—the scale of the surroundings needs consideration. But behind its plane face must be a structure with some provision for movement and ventilation, so that it is not surprising to find that numerous systems (patent and otherwise) exist for these purposes. There must also be provision for fixing locks, for protecting the raw edges of the plywood face next the shutting stile, and for precise adjustment of fit elsewhere. The first-named requisite is provided for by a solid core on the closing edge extending over the maximum likely variation in lock height; the second by a hardwood strip fixed to this edge; and the third by leaving top, bottom and hanging edge (which are not prominently seen) bare of such covering. A further necessary provision is one against chipping of the ply face during handling before fixing, plywood being easily subject to damage if roughly used. This contingency is fairly well met by allowing horns to remain on the door stiles until it is being prepared for hanging (Fig. 93).



FLUSH DOOR ESSENTIALS

FIG. 93

FOLDING AND SLIDING DOORS

Though it may sometimes prove expedient to fit sliding doors in situations where doors hung in the normal way would create obstruction, such a resource in the ordinary house is usually a confession of failure in planning. There is, however, a legitimate use for various forms of sliding or folding doors in places where it is desired that two or more normally separate rooms should on occasion be united, and the practice of doing so is growing. There are drawbacks, which it is well to recognise and face, in the endeavour to avoid the worst consequences by providing (as far as may be) against them. These are, briefly:

Folding Doors.—If carpets or rugs are intended, allowance must be made for them either in the form of a carpet fillet or sufficient clearance space, either of which is an unhappy arrangment under some circumstances. If the doors are to fold back against a wall either through an arc of 90 deg. or 180 deg., rearrangement of room furniture will probably be necessary. Projecting architraves present difficulty where 180 deg. swing is desired.

One leaf (or more if the doors are of double-flap form) must be secured top and bottom by bolts, which involves floor sockets.

If the unbolted leaf is required to serve as a pass door, its furniture may differ from the pattern in general use (e.g., flush handles may be

required). As the meeting stiles will be rebated, any lock used must conform.

Sliding Doors. — These require some form of track or guide at the bottom, which interferes with carpet or floor surface. Perhaps the best device is a loose or hinged threshold containing the guide, which can be removed or folded up when the doors have run into their nest.

Since a certain latitude of fit is essential, sliding doors are less draught- and sound-tight than other forms.

Provision for an overhead track is somewhat complicated (on domestic standards) and the necessary double partition to allow doors to slide out of sight consumes space.

Door furniture must be of flush pattern, without projections, which it is sometimes difficult to obtain in acceptable forms.

The various types of sliding and folding (concertina) doors seem hardly applicable to the private house, and are, in any case, costly.

Garage Doors.—The type of door descriptively known as "round-the-corner" has almost entirely ousted ordinary folding doors for entry to domestic garages. Its advantages are obvious; the doors are out of the way when open, and do not require securing against wind; the locking leaf serves as a wicket for personal access; the doors have less tendency to distort, and are neater in appearance. Their sole drawback (a minor one) is that since their successful working involves the provision of a bottom guide as well as an overhead track, and the two must be in exact alignment, it is necessary for cement floor finish to be delayed and for attendance by the floor layer to be arranged when the doors are being hung. Incidentally, provision for drainage of the guide channel by a few drilled holes, with outlet to external paving, is desirable.

"Round-the-corner" doors are usually of framed and braced construction, though, strictly, braces may be thought unnecessary except on the locking leaf, which alone is devoid of top support. Glazing is often provided in the upper portion of garage doors, but it is questionable whether this is advisable, since it encourages the use of a garage with closed doors for running repairs—a practice which has been the source of several fatalities from carbon-monoxide poisoning.

CUPBOARD DOORS

Wardrobe, brush and similar tall cupboards are preferably formed with raised bottoms above skirting level, in which case B.S. 6-ft. doors may be conveniently used with their heads lining up with room doors. It should not be overlooked that for small cupboards, such as the ranges popularly provided in modern kitchens, laminated plywood or blockboard (obtainable up to 2 in. thick) is a useful material. Doors may be cut to size directly from the sheet and hung with chromium-plated back-flap or butterfly hinges, giving an entirely flush face.

FRAMED PARTITIONS AND MATCHBOARD PARTITIONS

These are now so uncommon in domestic use that they may almost be ignored, their place having been taken by thin partitions built of slabs and plastered, or by studding covered with sheet material. There is, however, an occasional use for a framed partition in such a situation as a panelled cloakroom, where it is desired to screen a w.c. The matchboard partition may be considered dead.

CUPBOARD FRONTS

Very much the same conditions affect cupboard fronts, which commonly (and preferably) now generally merge in the general wall-treatment, except for their doors; or, as in the case of ranges of cupboards, consist entirely of doors, showing

merely the edges of horizontal and vertical divisions.

WINDOW AND DOOR LININGS

The Victorian custom of fitting all windows internally with wooden jamb linings and architraves, which presumably was in the nature of a survival from the boxed shutters of a slightly earlier age, has been discarded so generally that it is now unusual to find a house built with finish other than plastered window-jambs. Cost, and an increasing appreciation of simplicity, are no doubt factors in this change; possibly the liability which such linings have shown to suffer decay may also have contributed.

Door linings, on the other hand, are more frequently employed; where our forefathers might have used frames, we hang most doors to linings. There is little to be said about these, except that where the linings are not rebated but fitted with stops formed by separate strips nailed on (as usual in minor building), sunlight is apt to show gleams through the joint between lining and strip—particularly if all woodwork is stained. Painting is usually sufficient to obscure this almost imperceptible crevice.

The problem of successfully fitting frames to slab-partitions has already been discussed, but a means by which linings may be stiffened when they are so used may be worth mention. This was employed, and possibly invented, by the late A. J. Penty. It consists in the use of rebated linings increased in width so as to comprise the thickness of slab, plastering, and sufficient projection on either face to allow a cover-mould to be fixed against the back of the linings. As Fig. 94 shows, a 6-in. lining might be employed with a 3-in. slab partition, joints are well broken, and the lining has little chance of jarring loose, since it grips the partition and its double plastering firmly.

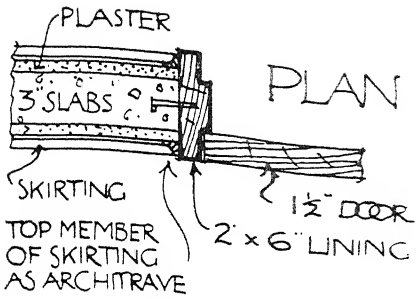


FIG. 94

A point so frequently forgotten as to be almost customarily so, is the probable desire of house occupants to lay carpets or rugs, which room doors must clear. The frequency with which doors, once hung, must be dismounted to have their lower edges adjusted is unbelievable, and when so adjusted the complaints of under-door draught which follow are likewise incredibly frequent. Both the difficulty and the subsequent complaint can be avoided if a hardwood carpet-strip be fitted to each opening (Fig. 95). Such provision not only

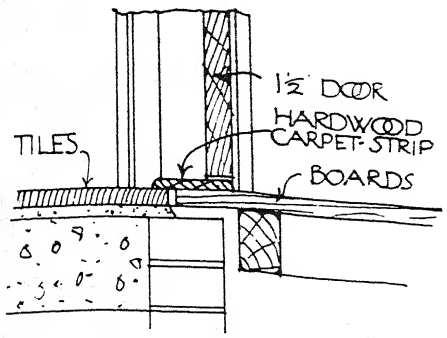


FIG. 95

solves this problem and makes doorways less draught-provoking, but is a useful way of covering change in the nature of flooring (as between tiles and wood) or in direction of boards. It is sometimes urged that people are apt to stumble and trip over such raised thresholds, but this is uncommon if the rise is restricted to ½ in. and edges bevelled or rounded. If

pile carpets and underlay greater in thickness than this are likely, rising butts in addition to the strip may be necessary.

WINDOW AND DOOR FRAMES

These items, grouped together, appear in this sequence in the B.S. Specification Trade Headings, but the former will usually have been dealt with when describing casements or sashes—as in this series and in B.S.S. 644. Solid frames in domestic work are usually restricted to external doorways, and since these will probably be built-in at or near ground level, they are the first details which should be supplied to the builder.

WINDOW-BOARDS AND NOSINGS

The wooden window-board has been largely ousted by the tiled cill (described under "Bricklayer," where the specially severe effects of sun and moisture on a window-board are mentioned), but in some situations, such as the framed apron of a bay window, wood is still the readiest resource, and, provided only narrow widths are called for, causes little trouble. It might be wished that the nosing commonly formed in this and similar positions was less often so coarsely detailed. A shape such as shown at "B" in Fig. 96 seems quite as practical as the more usual one at "A," and its firmer line is preferable.

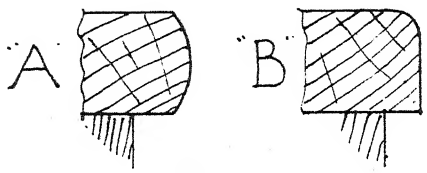


FIG. 96

ARCHITRAVES

The purpose of the architrave, as applied to door or other openings, is to cover the joint between a wooden frame or lining and a wall surface of other material such as plaster, brick or tiling. The designer of the strip material of which they are formed should have in mind two other incidentals: (1) that the section should be such that it will not prevent a door from being folded back almost flat against the wall face; (2) that, as fixing is commonly close to the thin edge thus entailed, it should not be too fragile. B.S.S. 584 gives a range of suitable sections (Fig. 97).

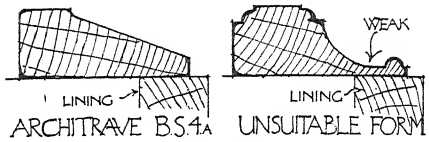


FIG. 97

SKYLIGHTS AND LANTERNS

The occurrence of a skylight or lantern in a small house is evidence of lazy planning. In larger buildings, or in additions, their use may be inevitable. An opening skylight in a sloping roof is one of the most difficult things to make effectively waterproof; a deadlight is easier. In the case of flat roofs, more frequent use might be made of the rather attractive little glass dome-lights, which are simple to use and free from complications, apart from the fact that they require a circular trimming.

CASINGS TO BEAMS, ETC., CAPPING, ETC., PILASTERS, ETC.

These items appear as headings in the Standard Sequence, but will seldom need to be included in the domestic specification. They suggest "features," which are out of place in dwelling-houses, where reticence is a more valuable quality than any effort to give interest, apart from the necessary furnishings.

SHELVING, ETC.

There are certain uses in the average house for which other materials

than wood are desirable for shelving, e.g., slate or tiles for a larder thrawl, metal tubing for a saucepan rack, but for most purposes wood has advantages, not the least being its comparative silence in active use as compared with a harsher material. For the several common purposes for which shelving is requisite, there are special variations of detail which may be worth noting.

Larder and store cupboard shelving is best arranged out of close contact with the wall behind. Not only is it a waste of labour and a reduction of effective width to notch out the back of each shelf to fit round the vertical bearers to which intermediate brackets of iron or wood are secured, but such treatment makes it more difficult to clean the shelving, leaves a corner and crevice for dirt and insects, results in the wall surface being constantly smeared when cleaning, and restricts the free flow of air which otherwise might pass behind shelves. It is preferable and easier to butt the back edges of shelves against the bearers uncut, leaving an open slit of ¾ in. to 1 in. in width against the walls (Fig. 98).

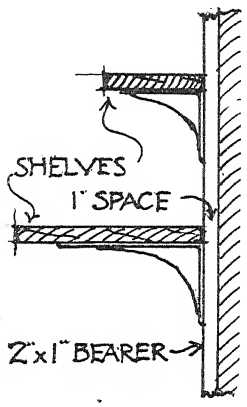


FIG. 98

Plate shelves. Plates and dishes for table use are preferably kept either stacked or in plate racks, and not spread out on a " dresser " to collect dust and grime. Wherever plates or similar articles are so displayed, however, arris-grooves should be formed to keep them in position. These used to be common practice, but apparently some modern workmen have never heard of them.

Bookshelves well filled give a furnished appearance to any room and are worthy of inclusion on that ground. The tendency when fitting shelving of all sorts is to over-estimate the width of spacing required. A table follows this section, in which the common height necessary to accommodate some everyday objects is given. In the case of bookshelves, however, it is desirable to make all intermediate shelves, between top and bottom, readily movable, and this is most conveniently done by fitting the strip-and-stud device known as " Tonks' fitting." An arrangement which is nearly invariably successful is to prolong across the recess formed on either side of a chimney breast shelving ranging with the mantel shelf, extensible as need dictates up to doorhead height—possibly with some reduction in depth in the upper tiers. Books are a heavy load and sagging shelves always look bad. With adjustable shelving which is *supported* but not fixed, ¾ in. thickness can be relied upon to carry quarto or large octavo volumes over a distance between supports of about 3 ft. without unsightly deflection.

Linen and blanket cupboard shelving, which is usually made up of spaced battens so as to encourage free circulation of air, is best made removable in sections so that it can be taken out for cleaning and possible disinfection. Infestation by moth is sometimes difficult to dislodge when the chrysalides can be secreted in inaccessible spaces. The interval between tiers should not be too great; if it is so, individual items of clothing or house linen are difficult to withdraw. About one foot is a fair average spacing. Where linen cupboards are formed beneath sloping soffits, one or more edge-rails for the purpose of hanging articles so that they become

properly aired (Fig. 99) are a useful provision, utilising space otherwise wasted.

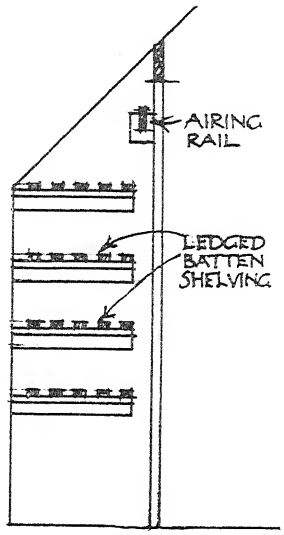


FIG. 99

TABLE OF HEIGHTS OF OBJECTS COMMONLY STORED ON SHELVING.

Jam pots, 1 lb. ...	5 in.
„ „ 2 lb. ...	6 in.
Bottled fruits, Kilner jars	8 in.
Tumblers	4½ in.
Plates: Dinner	10 in.
„ Pudding ...	9 in.
„ Cheese	8 in.
Store jars (salt, rice, etc.)	6½ in.
Medicine bottles ...	7 in.
Siphon	12 in.
Books: Quarto	10 in.-11 in.
„ Octavo	8 in.-9 in.
„ Pocket editions	7 in.
Folded garments, etc. Blanket, 16-fold ...	3 in.
Suit on coat-hanger (width)	20 in.

FITTINGS

The increased refinement of the fittings which it is becoming normal to expect in the modern house is one of the most revolutionary changes apparent when comparison is made with the relative bareness customary a generation ago. The "builder's dresser" and its companion wardrobe-cupboard were about the extent of the equipment then expected. Both are now dead—but not always decently buried. The factory-made kitchen cabinet killed the dresser, and wardrobes of the "Compactum" type the rather crude bedroom cupboard. Such fittings can always be procured at a price and with a finish with which no builder can compete, and it is only necessary to explain that the cost of designing and setting-out an individual example has to be borne singly, whereas this cost may be spread over some hundreds or even thousands of articles in the factory product, for the advantage in cost to become apparent; while, as to finish, the precision of factory work and the experience gained by an intelligent firm who have made numbers of articles having similar object fully accounts for superiority.

Another advantage lies in the fact that actual fittings, or convincing illustrations, may be studied by house owners, who are usually incapable of fully appreciating the import of a detail drawing. For all these reasons the most satisfactory method of installing the modern counterparts of dresser and wardrobe is to select suitable patterns (singly or in combination) from a specialist's list or showroom and to restrict work on the site to assembly and possibly adaptation or extension to fill spaces which only approximately suit the desired combination.

There are, however, one or two special fittings which might form part of the equipment of the small house with advantage to its users, but which do not seem to be included in the range of manufacturers' stock patterns.

A servery china-closet is a most useful and step-saving adjunct to such a house, when designed on the lines of Fig. 100. The essential features (sup-

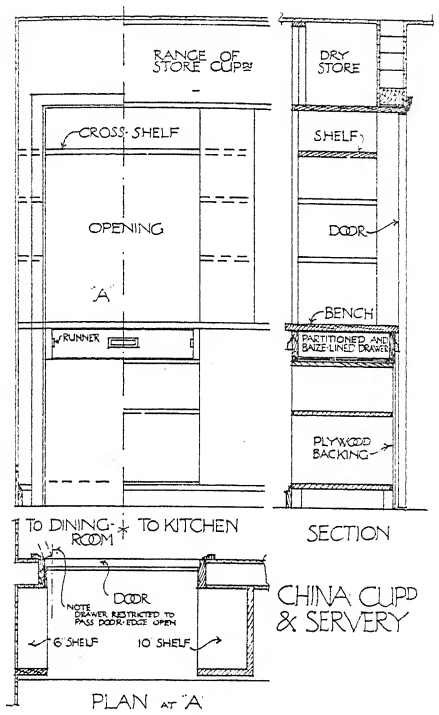


FIG. 100

plementing the actual hatch) are: (1) The cutlery drawer beneath the bench-top, double-faced and available from either kitchen or dining-room. This should be shallow, baize-lined, and with divisions, and should run on hardwood strips grooved into the sides of the drawer. (2) The shelving on either side of the hatchway, to contain articles of tableware in frequent use. (3) The supplementary cross shelf above the opening, giving additional space for small objects in addition to the bench area. On the dining-room side many people will prefer a standard full-height door to a hatch extending only over the actual opening, but this is not essential. A second door on the kitchen side is often thought desirable, and where its opening creates obstruction it is convenient and simple to arrange this as a lifting door, sliding upwards either on pulleys and sash-lines or, preferably, on a pair of compact spring sash-balances.

A tradesman's delivery hatch is particularly serviceable in the case of servantless houses which are likely to be often deserted, and is also useful in permitting articles to be delivered when the occupants are engaged upstairs or effectively deafened by attention to a noisy radio programme during which bells and knockers are unnoticed. A simple and effective device, which may occupy the upper panel of the trades door, is shown in Fig. 101. This consists of a

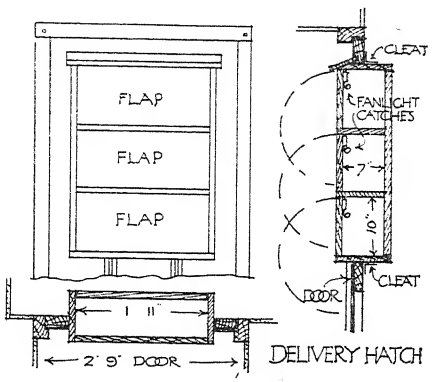


FIG. 101

case divided into compartments by shelving, each compartment being closed to the outside by a fall-down flap in such a way that when all the flaps are down the top compartment is exposed. Each successive delivery is followed by the closing of a flap, exposing in succession the next compartment below until all are filled. An ordinary fanlight catch which is *inside* when secured serves to fasten each flap. Access from within is gained by an ordinary hinged door. To make the fitting secure, this door should have a good lock, and the fitting should be internally fixed to the door rails by angle cleats or similar stout and inaccessible fixings.

Enclosing cabinets beneath lavatory basins and sinks are increasingly demanded on the score of neatness and "sightliness." An important point which should not be overlooked in

such cases is the need to allow "toe-space," by recessing the bases some 2 in. for a height of 4 in. or over.

Air inlets to bathrooms, w.c.s and similar flueless rooms are neatly and

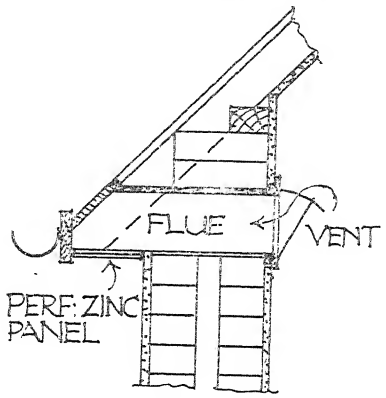


FIG. 102

effectively formed as shown in Fig. 102 at such a level that their external opening occurs in the eaves-soffit, where it is covered by a square of perforated zinc. Such an aperture is unaffected by birds' nests, which often occupy ordinary air-vents, and does not permit driving rain to blow through, as often happens in exposed positions customarily treated. Externally such inlets are almost unnoticeable, and this is particularly valuable in tile-hung houses where the formation of wall-openings is not only unsightly but difficult.

JALOUSIES AND SHUTTERS

The provision of external shutters to south and west windows can often do a great deal towards internal comfort—either during periods of intense sunshine or rough weather. The shutters, moreover, can be the means of livening up the appearance of a house, particularly by the introduction of colour. To get full advantage from such shutters, the windows to which they are fitted must either be inward-opening casements (as customary on the Continent) or lifting sashes; casements which open outwards cannot be used to give ventilation when sun-shutters are closed, except to the limited extent permitted by the depth of reveal.

Shutters themselves may be either ledged, panelled or louvred, the latter form offering most advantages. They may also be hung either folding or sliding, and in the case of louvred shutters this affects the inclination of the louvres, which should weather and screen outwards in the closed position.

Louvred shutters, which consist of a frame filled with inclined slats somewhat similar to a Venetian blind, frequently err by being too coarsely detailed. Londoners may see perfect examples fitted to the Norman Shaw house in Queen's Gate, where the added convenience of a push-out louvred panel to the bottom section can be used to admit extra light and air if desired (Fig. 103).

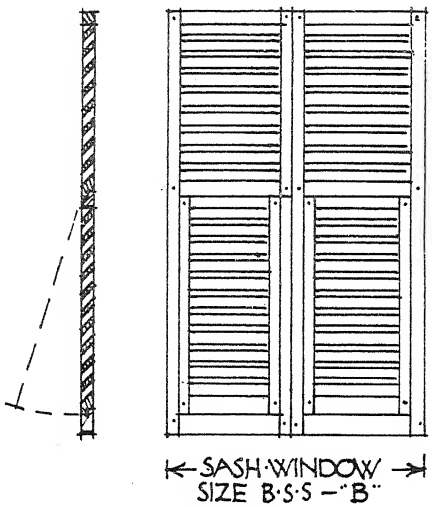


FIG. 103

When ledged or panelled solid shutters are used it is advisable to include a few perforations (which can be utilised with decorative effect), as otherwise rooms will be in complete darkness when shutters are closed—a condition which may preclude their frequent use. It may be worth noting that during the Great War, when

dimming regulations were in force, many occupants of houses fitted with shutters found them of great use, as much the simplest way of compliance. One rather wonders what the owners of the fashionable glazed-aquarium type of house will do in like circumstances!

SINKS

Despite the onset of the stainless metal sink unit, now obtainable with a sound deadening backing, there is still a demand for teak wash-up sinks on the score of reduction of breakages. Increased convenience in use results if these are formed as double sinks, with a central division over which a swing tap having hot and cold valves is placed so that it can deliver to either half. This arrangement permits hot washing and cold rinsing to be readily arranged, or, on occasions, both divisions may be hot or only one in use for minor purposes. The construction can be as usual, front and back continuing beyond the ends and below the bottom, which are then grooved or housed thereto and tightened up by external copper bolts. The centre division is also housed but secured by screws and slotted cups to allow trifing movement (Fig. 104).

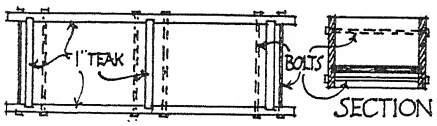


FIG. 104

DRAINING-BOARDS

Pottery or teak sinks require wooden draining-boards, and no sink is completely fitted unless supplied with a draining board at each end. Where space is limited it may be permissible to arrange one at right angles to the sink (Fig. 105a) or to set the sink across a corner, making both draining-boards at 45° (Fig. 105b). The boards should be of hardwood—preferably teak—should have an inclination of not less than 1 in 30, and should be throated beneath close to their delivery end to prevent greasy water from running back beneath. There should be a raised fillet along the outer edge, but opinion seems divided as to the wisdom of drainage grooves. Though these are still customary, some people prefer a flush top lined with good quality lino fixed with a waterproof adhesive like the counter-tops now commonly supplied in cafés and similar places.

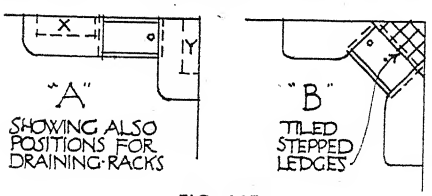


FIG. 105

The most convenient height at which wash-up sinks should be fixed may profitably be considered here. Obviously it is dependent to some extent upon the stature of the user, so that average height only can be considered, but housekeeping ladies show a tendency to petulance in accusing architects and builders of lack of consideration in this matter, which often shows that they fail to appreciate the fact that more than one factor enters. A sink whose rim is more than 3 ft. above floor level will prove difficult to negotiate when heavy saucepans or other vessels have to be lifted out. On the other hand, such a sink 10 in. in depth involves a cramped bending position when performing washing-up at the level of its bottom. The solution lies, not in varying the height of the sink, but in the use of a washing-up bowl raised above the bottom on a stand—there is a type obtainable in which the stand contains a detachable strainer having the admirable effect of holding up matter which might otherwise clog the sink outlet.

PLATE RACKS

The position of a draining-rack needs care in its choice. It should not

be so placed that drippings will descend upon the hands of persons using the sink, and it should be so situated that articles can be placed in it with the minimum of effort. The ordinary right-handed person when washing-up will hold things in the left hand. Experiment will show that positions above the left-hand draining-board or at the right of the right-hand one (X and Y in Fig. 105) are most convenient in use.

PIPE AND CISTERN CASINGS

Nothing need be said of the normal type of pipe-casing, but there is a form of pipe-enclosure which has been brought about by the adoption of that class of cooker or boiler which may be grouped as "close control." These types usually involve connection to a brick chimney by iron or asbestos-cement flue pipes which look crude and ugly if left exposed—particularly if their course entails bends and raking lengths. To make a virtue of necessity in such cases, the enclosure of the unsightly upper portion of their course by a cupboard provides perfect storage for such things as crisp-bread and biscuits. The aperture in the cupboard base through which the flue enters should have a diameter at least 3 in. greater than the flue pipe, and it is advisable that the inner face of the door and any other portion of the cupboard framing within 6 in. of the pipe should be protected by a sheet of asbestos-cement fixed thereto with a space formed by distance-pieces of asbestos (Fig. 106).

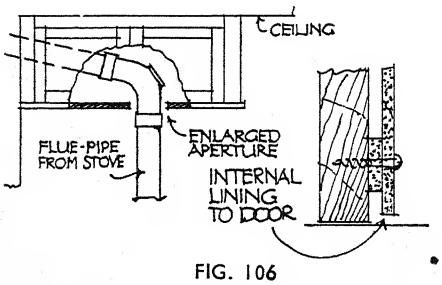


FIG. 106

Cold cisterns in roof-spaces or similar draughty positions should always be protected by a casing and cover, the simplest provision being a boxing of g. and t. boards allowing a space of about 4 in. round the sides and bottom of the tank, filled with sawdust, and fitted with a close-fitting lid. Complications arise where connections enter or leave the cistern, and where the drip-pipe which terminates the hot water expansion pipe overhangs the cover. For the latter a perforation must be provided, and it is important to ensure that neither this nor the pipe which should discharge through it can be readily displaced—otherwise excitement may arise from suspected leakage of cistern or roof!

Connections to the cistern are normally three at least; the rising main, down service, and branch to hot water system. The two latter will be fitted with screwdown stop-valves which are preferably fixed directly to the cistern with backnuts, as otherwise a fracture of intervening piping would be uncontrolled by the valve. These accessories necessitate interruption of the casing by a recessed boxing to allow access to the capstan-head of each valve.

The casing of a cold cistern is not only desirable against frost but will prevent condensation forming and dripping off so as to saturate the ceiling beneath.

STAIRCASES

There is a B.S.S. for wooden stairs —B.S.S. No. 585, Wooden Stairs— which gives minimum requirements. A bad staircase is troublesome or at the worst can be dangerous in use—the first considerations therefore are practical ones. It should not be necessary in any new house of average size to depart from any of the following design features:—

(1) Treads and risers should be equal throughout, and floor levels (if varied) should be set out on a storey-rod to ensure this.

(2) Winders and single steps dividing a landing should be avoided.

(3) Flights should never exceed 12 steps without the break of a quarter or half-space landing. Still shorter flights are preferable.

(4) A continuous handrail between newels (preferably on the inner side of a stair which has a turn in it) should be provided. To arrange this in the case of a dog-leg stair needs care and ingenuity and bungling often occurs.

"GOING" OF STAIRS

A great deal has been said and written on the desirable proportion of tread to riser, and many empirical formulæ have been produced, all based upon the average stride as influenced by the extra effort entailed by lifting. One of the simplest to remember and apply is: Tread x riser equals 60 to 65. Taking the average small house with 8-ft. storeys, the height from floor to floor will be approximately 8 ft. 9 in., which is equivalent to fifteen 7-in. risers or fourteen 7½ in., giving approximately 9½-in. treads to the former and 8 3-5 in. to the latter. In practice, 9-in. treads (10 in. over nosings) work quite well with either.

CONSTRUCTION

A staircase with the elaboration of cut strings has become uncommon, and is rendered more so by the prevalent liking for solid or flush-lined balustrades. There is no denying the fact that most wood stairs creak in use after a building has thoroughly dried out, and the normal practice in construction, despite wedging, carriages, blocks, and glueing, seems powerless to prevent it. The normal "good" method of jointing treads and risers is as shown at "A," Fig. 107; it is perhaps noteworthy that one of the few stairs which in the writer's experience did not creak was found to be constructed as at "B," which many craftsmen might be inclined to rank as "jerry" work. It is a method which obviously aimed at using narrower boards for the treads —presumably the edgewise stiffness of the risers has a girder effect in supporting the treads.

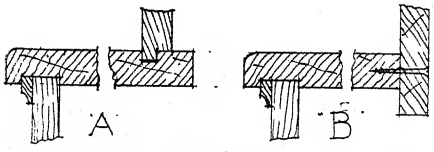


FIG. 107

NEWELS

Hulking great newels—even if they are not elaborated with coarse enrichment and an obstructive cap—are a legacy from bad periods of architecture. In the simpler work of the late Georgian era, newels have often been surprisingly slight; 3 in. or 2½ in. is not uncommon. In the average house 3½ in. square should be a maximum size, and there is both practical and æsthetic advantage in making the pivot-newel at the turn of a reverse flight rectangular and equal to a coalition of two squares. By this means, coupled with care in detailing, the common defect of clashing between string and handrail where they cross can be avoided. This also was common practice in Georgian times.

HANDRAILS

Handrails are essentially of three kinds—those of upright section meant to be gripped (a) (Fig. 108); those of broad section upon which the hand is

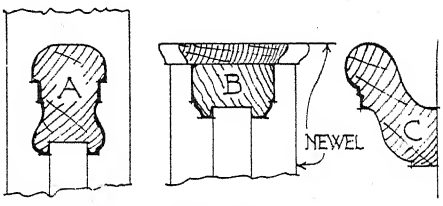


FIG. 108

rested (b); and those set at an angle for attachment to walls (c). Each has its uses; (a) is specially useful where space is limited, particularly at the point of difficulty mentioned above where strings and handrails cross. In such positions a broader handrail lessens finger-space and makes the problem needlessly difficult; (b) is generally the most dignified and may be thought preferable in well stairs having quarter-space landings; (c) should be restricted to positions where other alternatives would fail.

BALUSTRADES

Housewives seem united in demanding the solid or flush balustrade (or "banister" as they insist on calling this feature!), but it should be remembered that when a hall depends chiefly on light from a flanking staircase window a great deal may be blocked out by it.

Where a solid balustrade extends alongside the stair well against a landing the horizontal portion is better raised so as to leave a space of 3 in. next the floor. This aids ventilation and avoids a dirt-harbouring angle.

CURTAIL STEPS

In a small hall, the setting back of the first stair-newel so as to form two or three curtail steps can have considerable influence on the feeling and reality of available space. Where (as so often happens) the start of a stair consists of a few steps at an angle with the main flight, this effect can be further improved by allowing increased width to this short preliminary flight—especially when fully adequate width cannot be afforded for the principal run. 45° curtails are superior in appearance to quadrant or bullnose.

LANDINGS

A cramped staircase can often be greatly improved in convenience if it is possible to allow extra space on half-landings (Fig. 109). This gain need not suffer even if insufficient height exists towards the margin of the extended landing, provided that some means is devised to keep users away from the low portion, as shown.

IRONMONGERY

Though in the B.S.S. sequence ironmongery or hardware appears separately as the last item of the joiner's trade, it is generally found more convenient in work of modest scale, such as the average house, for the items to be described together with the doors, windows, and suchlike to which they are accessory, and in several instances where remarks seemed desirable in this series they have already been made in passing. A few general observations, therefore, alone remain to be added.

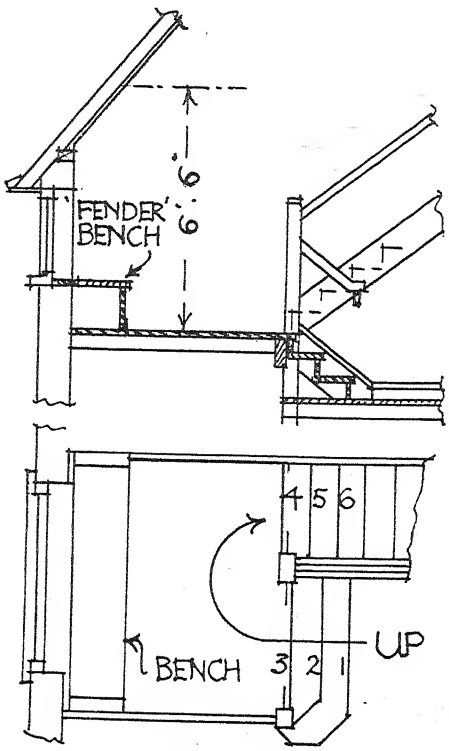


FIG. 109

It is, of course, obvious that ironmongery is among those things which are chosen, and not specially made, and that choice is limited by what is available. To some extent it is further limited by the operation of the patent laws and registration of design, which may mean that desirable fittings would have to be obtained from an impossible variety of sources if the absolute best were aimed at. Such counsels of perfection are, however, unusual, and most of the big makers and principal factors can supply a range of fittings adequate for the occasion.

Locks are among the most important items of hardware in the house. Bad locks seem less common than formerly, and can be avoided altogether by adherence to B.S.S. 455, which deals with steel cased mortice locks (5 in. and 6 in.). The more recently popular upright mortice locks in which latch spindle and keyhole occur vertically above one another are not yet covered by a specification, nor are the tubular locks, for which mortices are prepared by boring with a centre-bit into the lockrail. Good types of both are, however, available, and reference to the before-mentioned B.S.S. will give *some* guidance on points to be looked for.

External door locks are now so generally of "Yale" pattern that this may almost be said to be customary. Until recently it was an unfortunate necessity that these fittings should be in a finish which agreed with nothing else in the house, but latterly all usual surfaces have become obtainable. The importance of an extended face-plate with edge fixing has already been stressed.

DOOR FURNITURE

The one-time invariable provision of knob, finger-plate and escutcheon on each side of a room door has been disturbed by the convenient "lock set," in which latch-spindle and handle, keyhole, and faceplate are combined in one fitting, with increased neatness of effect and considerable gain in outlay. This upright arrangement has either resulted in or been caused by the adoption of the lever handle, which in itself has many advantages in ease of operation, and only one (easily averted) disadvantage in that, unless counterbalanced by a special spring, its weight hangs permanently on the lock-spring, which is apt to become "tired," so that the latch operates but sluggishly or fails altogether. It is important, therefore, to select patterns embodying this extra spring. A knob handle used on the upright type of lock is apt to result in injury to the knuckles of users, owing to the reduced clearance between knob and door-frame or lining.

A manifest advantage of the combined fitting is that it throws the necessary screw fixings clear of the lock in its mortice. This is especially useful in the case of all handles relying on the faceplates to retain them on their spindles. We can all remember, even if we do not still retain, examples of handles perilously secured by grub-screws, which failed in exact adjustment or came off most inconveniently. Pitt's, Mace's, and several other patent securing devices changed that, but some of the expedients left the handle dependent on the hold of its roseplate, feebly secured by three short screws biting only on the thickness of door left by morticing the lock. Fig. 110 shows (a) this condition, and (b) the alternative of

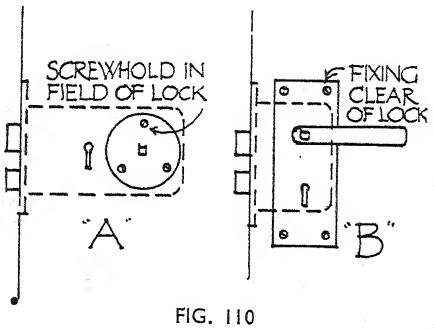


FIG. 110

the combined fitting. Latterly these combined fittings have become available also in plastics, though it may be hoped that designs will show general improvement beyond what is commonly offered now.

ENTRANCE DOOR FURNITURE

Knocker and letterplate are usually affixed to the main entrance door, but a necessity which is often overlooked is some form of closing ring or knob. It should not be forgotten that the Postmaster-General has besought architects and builders to have regard to the postman's need in the size of letter-slits provided, which he suggests should be at least 8 in. by 2¼ in. A type of combined fitting which fulfils the needs of knocker, letter-slit and closing ring is shown in two forms (vertical and horizontal) in Fig. 111. It is necessary to say that the springs to the letter-flap should be strong, as these big flaps offer a good deal of windage; also that the vertical type should be side-hinged—if top-hung nothing will prevent chattering in high winds.

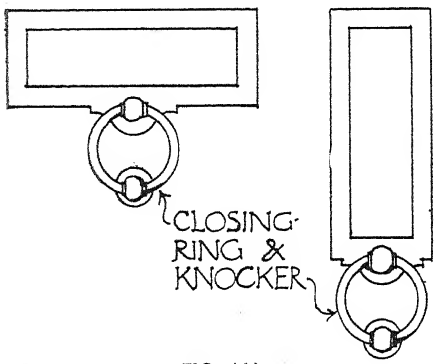


FIG. 111

WINDOW FITTINGS

The one-time universal pulleys and lines for lifting sashes are now seriously challenged by various types of spring balances, in considering which intending users should require to be convinced of the relative noiselessness of the device in operation—some emit fearful sounds when used. The rudimentary sash-fastener which endured so long despite its invitation to unauthorised entry (though this sometimes proved a convenience in case of forgotten keys) has now receded into the background in favour of types less susceptible to operation by a knife-blade, and with the added advantage that they tend to draw the two sashes together in closing. Sash lifts should not be forgotten, and sash pulls for the upper sash are often advisable also.

Casements now tend to be specialist productions, each with appropriate fittings, but in the case of wooden windows of the ordinary type, fitted with cockspurs and staybars, it is always worth while spending an extra twopence per opening-light on the provision of two pins to each stay and two slot-plates to each cockspur. By skilful adjustment of pins the staybar may be used as a lever to ensure tight closing of the window, while the extra slot-plate, if fixed as shown in Fig. 112, will protect the tender edge of the wood frame or mullion from careless damage by the spur and also enable the window to be set so as to afford slit ventilation when desired.

SLIDING DOORS

Cupboard doors mounted on runners and metal rails may create a thunderous noise when operated—particularly if glazed doors are in question. It is worth knowing that as an alternative, rails of a synthetic material upon which the doors run upon smooth slides of similar composition give silent operation.

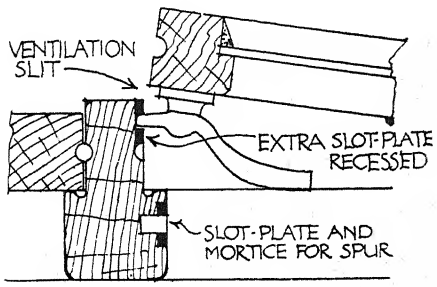


FIG. 112

SMITH AND IRONFOUNDER

GENERAL

The above section-heading, consecrated by long use, still appears, and will doubtless continue to appear, in specifications for domestic work, to which the more prosaic " Steel and Iron Worker " of the Standard Sequence seems less appropriate—however suitable for constructions embodying steel and iron in more than incidental form.

According to the present trend of custom and fashion this section might quite easily disappear. It formerly consisted, in the main, of three classes of subject: rainwater goods, stoves, and miscellaneous accessories, the latter embraced by some such ambiguous clause as " provide all ironwork mentioned in other parts of this specification." Several such items (e.g., airbricks) have already been dealt with in earlier instalments of this series.

MATERIALS

There is no longer the necessity to specify qualities in detail. The number of B.S.S. covering different productions in iron and steel suffice for all ordinary building needs, commencing with B.S.S. No. 4, " Channels and Beams for Structural Purposes," and extending to No. 693, " Oxy-acetylene Welding as Applied to Steel Structures "—some 20 in all at the time of writing. By stipulating compliance with the current B.S.S. for any component, reasonable standards for everyday use may be ensured.

RAINWATER GOODS

Few of the simple components of building carry with them such potent causes of future trouble as the common eaves gutter and downpipe. The former is frequently inadequate, stupidly fixed, and liable to fall, and the latter so placed that essential preservative painting is impossible—as a result, more damp walls can arise from presence and neglect of gutters than from their total absence.

GUTTERS

The most popular form in domestic work is the half-round gutter. Its actual capacity is low, and liable to reduction by tilting of either edge. The deep half-rounds which are made, or a size larger than the minimum, are preferable. It is worth noting that stop-ends are frequently contrived by workmen out of wood and red lead—usually found defective after a year or two; the correct fitting should be used.

Gutter-brackets for half-round gutters may be strap-brackets screwed to the rafter feet if no fascia is provided, or fascia-brackets if fixing exists. The former need to be supplied and fixed *before* roofing is laid, and since their fixings will be covered and inaccessible afterwards, are preferably secured with brass screws. Either type of bracket should be furnished with a clip which will secure the gutter from movement or tilting when a ladder is reared against it. (Fig. 113.)

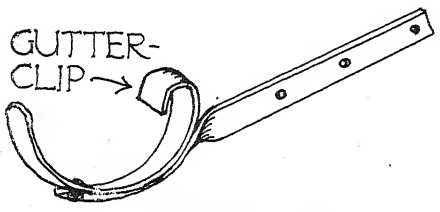


FIG. 113

Ogee or moulded gutters are sometimes used to obtain the effect of an eaves cornice. The screws fixing such gutters are particularly subject to rusting, and when decayed may allow the guttering to fall—especially when snow slipping off a roof puts a strain upon it. Stout brass screws are therefore desirable. The question whether sockets are to be external or internal will arise. The former destroy the line of the "moulding," but preserve the waterway; the latter look better, while inspection of many gutters leads to the opinion that (sockets or no) water usually lies in the bottoms after rainfall.

Gutters intended to be supported upon brick or masonry ledges or corbel-courses should have some provision against leaking joints caused by inevitable expansion or contraction. This is a matter for the plumber, but is most appositely mentioned here. The simple provision is a lead soaker with welted edges and "drip" at the free edge fixed beneath each joint. (Fig. 114.)

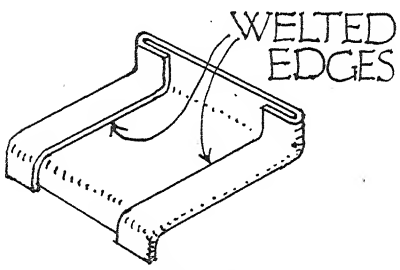


FIG. 114

DOWNPIPES

The measure of size of a downpipe usually depends upon its liability to become blocked rather than its carrying capacity. Nothing less than 2½ in. should be used, and it is wise to see that the outlets cast on guttering are not so small as to restrict the clearway at this vital point. It is usual to fit wire balloon grids over each outlet, but their usefulness may be doubted. Unless frequently cleared they are generally found holding up leaves and debris so that gutters overflow.

The fixing of downpipes should aim at securing the possibility of painting. For this reason positions in angles should be avoided, and by one or another means the pipes should be projected at least 1 in. clear of the wall-faces behind them. Until quite recent times R.W.P. embodying any provision to enable them to be thus fixed have been disproportionately expensive, so that recourse has had to be made to extraneous means such as wooden bobbins or iron pipe-distance-pieces behind the flat projecting ears, both necessitating longer nails and a certain loss of rigidity. Latterly, however, several types of piping supplied with ears of special form designed to throw them forward from the wall-face have become available at moderate cost, and their use should be encouraged. The common essentials of cylindrical rain-pipes are defined by two B.S.S.—No. 460 (Light) and No. 416 (Heavy). There is a good deal to be said in favour of the growing practice of using asbestos-cement gutters and rainwater pipes, which require no painting. These also form the subject of a B.S.S.—No. 569.

STOVES, RANGES AND BOILERS

These at one time formed an important part of the "Smith and Founder" trade, but modern practice reduces their importance in several ways. Their actual number decreases with the spread of alternative ways of heating; their substance changes from iron to fireclay and ceramic materials; and the increasing complexity of the survivors causes transference of cookers and boilers either to a general class of "provisional amounts" or to the "Hot-water fitter" section.

METAL SASHES AND CASEMENTS

These items are also apt to be considered under other trades, since they

became so usually standard types. When fitted in wood surrounds they can be dealt with by the carpenter and bricklayer, under both of which heads remarks have already been made. As P.C. sums they will appear in the final schedule; there is therefore little need to trouble this trade about them.

RAILINGS, GATES AND OTHER WROUGHT IRONWORK

Such accessories, when included, will usually be covered by provisional sums. It may not be out of place here to plead the cause of the local blacksmith when such interesting and minor embellishments as strap-hinges, sundial gnomons, weather-vanes, or brackets are under consideration. Quite often a good local smith will deal with such items faithfully and well, with an interest and individuality superior to some firm from a distance, and at no greater cost.

MISCELLANEOUS IRONWORK

This comprises such things as chimney and bearing bars, core and hand-rails, bolts, tie-rods, and straps, staybars and so forth, all of which will find mention in connection with the construction to which they apply. Their occurrence at all is unusual in domestic work—except possibly the chimney-bar called for by bye-laws where jambs are less than 14 in. on face, and the inevitable hollow-wall tie, as to which it seems necessary to say that the wretched devices consisting of skimpy bits of twisted wire should be totally rejected. There is a Wall Tie Manufacturers' Association, whose products can be specified with confidence as being substantial and heavily galvanised.

PLASTERER

MATERIALS AND GENERALLY

No craft has been more adversely affected by easier distribution of its materials than has that of the plasterer, which is dependent on a combination of physical incorporation and chemical action for the success of its operations. In the old days when each locality depended in the main on its own productions and its own men, the behaviour of its local lime and sand had become so well known by a process of trial and error which had built up a sure basis of experience, that trustworthy workmanship could be relied upon. More leisurely procedure was a further help to a trouble-free result.

Those days will never return, and the alternative to the vanished knowledge of experience must be scientific knowledge of properties and processes, which have not yet arrived at the stage when they can be made available for general application, though progress has been made to the verge of that condition. It may be hoped that when that greatly-to-be-desired stage is reached, simple terms which can be freely used may be attached to the various materials—" lime " and " gypsum " are easy words to use; so are " Portland " and " Keenes "; but " retarded hemi-hydrate," though it may be scientifically expressive, cannot hope for popularity. The simplification of scientific terms, or their substitution by words of greater handiness in use, is no easy matter, but failure to accomplish it must militate against progress in the direction of a full employment of the results of experiment and research. At present the loose application of such terms as " cement," " plaster," and names which are assumed to be precise in their implication (such as " Keenes ") but which really give no indication of exact compliance with any standard, are a handicap.

The common materials of the plasterer are lathing, Portland cement, lime, gypsum, and sand or grit. Various forms of blocks or slabs and wall-tiling also come within his ambit.

LATHING

Lathing may now be either a form of the old wood lath—generally sawn fir but still occasionally rent-oak, which is the most reliable; or it may be a type of fabricated wood lath in which sticks and wire are woven together and supplied in rolls which are nailed up by the plasterer; or it may be metal lath (either expanded metal or some other form); or, again, it may be sheet material such as plasterboard or fibreboard. Again, there are patent materials such as " Bricanion " (brick and iron) consisting of a wire mesh upon which " blobs " of plastic clay have been burnt to brick-like consistency. Each form of plaster-base has its technique, neglect of which may occasion trouble or failure, the severest test being in horizontal work such as ceilings and soffits.

Wood lath depends for its plaster-holding qualities on its correct spacing; and for the further soundness of ceiling work, upon sufficient stiffness, upon broken butt joints, and upon plane surfaces which will permit a relatively even thickness of plaster. *Spacing* should be such as to allow approximately $\frac{1}{4}$ in. to $\frac{3}{8}$ in. for the formation of " key "; less than that gives a weak neck to each key, while more is expensive in plaster, and liable to cause dropping of the undercoat while plastic. *Stiffness* is attained by the use of " lath-and-

half '' quality, about $\frac{1}{4}$ in. thick, but even so there is with some sawn lathing rather more spring than is desirable. Spacing of joists or studding is also of importance in this connection, and for ceiling work 14 in. clear apart should be an absolute maximum. *Cracking* is rendered less probable if the heading joints of lathing are frequently broken so that a continuous line of weakness is not offered. *Even thickness* is made more possible by avoidance of lapped heading joints, butting all such joints upon a joist, and double-nailing.

Two further points relative to wood lath sometimes escape attention. (1) Any specially wide timber scantling or any boarded surface such as the dormer-cheek shown in Fig. 55 should have counterlathing fixed below the laths so as to permit the formation of a key. (2) When using sawn fir lath in dry conditions in conjunction with quick-setting plaster, it is possible for the plaster key, having set hard, to be nipped and fractured by swelling of the laths from absorption of water from the still wet plaster. This is unnoticeable at the time, but may result in fallen ceilings at odd intervals when shock or vibration severs the keys which have remained sound.

Nails used for securing lathing should not be subject to rust, which may result in spots developing on the plasterwork.

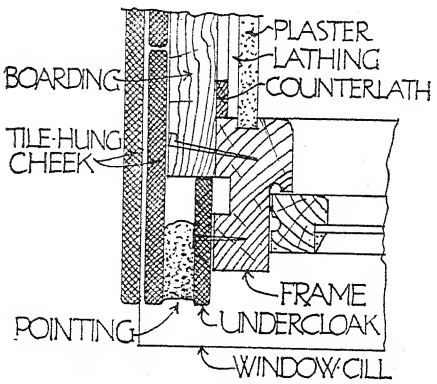


FIG. 55

Metal lath has superior qualities of strength and fire resistance, and is less subject to '' cracked ceiling '' trouble than wood lath, provided suitable plaster materials are used, and a lap of at least 2 in. is arranged at joints. Some types of calcium sulphate plasters are liable to corrode any ferrous metal in contact. The subject of ceiling-plastering on metal lath is fully discussed in B.R.S. Notes, Second Series, No. 95. Briefly, an undercoat capable of developing strength within a few hours is recommended. Expanded Metal (Steel) forms the subject of a B.S.S. No. 405.

Plasterboard as a base for plaster finish on joists or framing has gained vastly in popularity in recent years. This material consists of a layer of gypsum plaster between two layers of paper. It is nailed with flat-headed '' clout '' nails round the edges (and perhaps intermediately); it can be cut readily with a saw, and is finished with a skimming coat of quick-setting plaster. B.R.S. Notes, Second Series, No. 113, gives useful advice as to possible defects and precautions with this type of plaster finish. The spacing of joists, rafters, or studs to coincide with standard width of the boards employed, and insertion of cross-firrings to secure heading joints are essential. The use of '' scrim '' over joints is a useful precaution against later visibility of these, sometimes they tend to show as a pattern after the lapse of a few months.

Fibre-board, though more often used as an alternative for plaster (in which case the joints present a special problem) is also employed somewhat similarly to plaster-board. It is available in larger sheets, so that joints are fewer, but conversely their chances of showing become greater, so that scrim (wire-scrim preferably) is advisable. With these reservations, similar precautions are required. It will, of course, be recognised that not all fibre-boards are equally suitable as a base for plastering, and that only skimming coats are applicable in most cases. See further pages 83-85.

PORTLAND CEMENT

The use of Portland cement for such purposes as external rendering, roughcast, screeding for tiles or pavings and the like, is now reasonably well understood and the material itself so closely standardised under B.S.S. No. 12 as to be one of the most reliable building materials available. Failure, when encountered, rarely arises from the material itself, but from misuse. Almost every conceivable use of cement is fully discussed in one or other of the free booklets issued by the Cement & Concrete Association, 52 Grosvenor Gardens, London, S.W.1. Briefly, the commonest causes of failure in rendering, screeding and suchlike applications are: (1) Too dry and absorbent a base and failure to keep work moistened during induration; (2) dirty or unsuitably graded sand; (3) overworking of material after application; (4) incorrect proportions of mix or too much water; (5) frost, hot sun, or drying winds—somewhat related to (1) above. Beyond its use externally and for screeds and renderings, Portland cement is sometimes employed by plasterers as a gauging for lime plasters, the workmen preferring this material from their familiarity with its properties and behaviour. Subject to correct employment, there is no objection to this practice, which may be found fully discussed in B.R.S. Notes, 3rd Series, No. 221, where the addition (just previous to use) of one part of Portland cement to 10 parts of sanded lime coarse stuff of ordinary composition —nominally 1 : 3—is stated to be suitable. Such gauged stuff can be safely used up to two hours after mixing.

LIME

In a comprehensive summary of Building Limes issued by B.R.S.,[16] it is pertinently said: " The composition of the raw material used for lime-burning varies considerably and this necessitates different burning treatment and leads to the production of a series of limes differing in properties; the methods of slaking must also be suited to the particular lime." These wide differences of nature and treatment, as much as actual inferiority of product, are at the root of many serious troubles experienced in plasterwork now that definitely established local practice with local material is no longer the rule but the exception. The generally recognised classes of lime are:

(1) *Non-hydraulic* (pure, fat, or chalk lime) which is a white quicklime, usually slaked to putty and only hardening when in contact with air. While in the form of a stiff, moist putty the material improves by storage and many old-style builders maintained a stock of run-lime available for use—the risk of subsequent " pitting " of plasterwork, due to unsound or slow-slaking particles in the lime, is greatly reduced by the soaking. A modern development is the controlled factory slaking of non-hydraulic lime, which is then ground and sold bagged as " hydrated lime " or under proprietary names. This is in condition to be mixed as mortar or plaster straight from the bag. A standard specification may be expected, but for the present a guarantee that such lime complies with the soundness test recommended by B.R.S. affords a safeguard.

(2) *Moderately hydraulic* (greystone) lime, which owing to the presence of impurities possesses some hydraulic properties if the plaster is used within about eight hours of mixing. Apart from this quality, use and treatment for plastering may be generally similar to pure lime, but a fine screen is desirable to remove lumps and slow-slaking particles. Dry hydrates are also obtainable and should be purchased subject to guarantee as before.

(3) *Eminently hydraulic* (blue lias and chalk marl limes) are employed

16 B.R.S. Questions and Answers, 3rd Series, No. 243.

chiefly for setting masonry or brickwork.

GYPSUM PLASTERS

Most of the proprietary plasters obtainable are calcium sulphate plasters prepared by the calcination of gypsum. These may be of two classes. (1) Anhydrous accelerated, or (2) Plaster of Paris (hemi-hydrate). The latter may have been subjected to accelerative treatments which render it acid, neutral or alkaline; if acid, corrosion may attack metal lathing or embedded conduits. The behaviour of plaster prepared from these materials differs essentially from lime (calcium carbonate) plaster, both as to application and in subsequent use. Most of such plasters set very rapidly and with a hard, smooth surface which " sweats " heavily and is very resonant, so that such sounds as the click of a lock are intensified and become very evident. Cracking, when it occurs, is also apt to be much more pronounced and difficult to make good, owing to the unyielding nature of the material. Ceilings cracking during still night hours, moreover, produce a most alarming sound, almost approaching that of a pistol-shot. A good deal of work has been done by B.R.S. and B.S.I. in investigating peculiarities of behaviour of proprietary gypsum plasters, with the ultimate aim of standard performance being embodied in a specification which may some day be issued. In the meantime, B.R.S. Questions and Answers is a mine of information on pitfalls and precautions.[17]

SAND FOR PLASTERING

Practically three-quarters of the bulk of plastering consists of sand. In most districts that used by plasterers will be of local production, and it may be river or sea sand, pit sand, or crushed rock or stone. An equivalent for undercoats is also sometimes sought in crushed clinker or ashes, producing black plaster. Such black mill mortars appear to require an exceptionally long drying period.[18]

This natural or artificial aggregate is just as much responsible for the success of the resulting plaster as the lime or cement. Cleanliness (or at any rate freedom from deleterious components such as salt, clay or silt in proportion greater than 5 per cent., or particles of unconsumed coal), good grading, and angularity of grains are all important qualities. Over-fineness of sand is a frequent cause of plastering failures. B.R.S. Notes, No. 235, in Series 3, fully discusses desirable properties, and causes of weakness arising from improper choice of sand.

HAIR

The use of hair in plaster is discussed in B.R.S. Notes No. 180, 3rd Series, the general conclusion being that under modern conditions it is likely that the expenditure on hair and on labour of its incorporation might more profitably be used in improving the quality of the mix in other respects—as by a gauging of Portland cement in the undercoat, to which, as a rule, the application of hair is restricted. Experiments have shown that the amount of hair customarily used, even when well distributed, is not in itself sufficient to bear the weight of a ceiling, supposing keys to have broken.

PARTITION SLABS

As well as the clinker or breeze slabs already mentioned under " Bricklayer," numerous forms of plaster slabs similar in purpose are obtainable from specialist firms, and a very light, strong partition can be built using this material, with the

17 B.R.S., 1st Series, Nos. 31, 43, 50, 130; 2nd Series, Nos. 6, 31, 83, 95, 99, 113, 114, 117; 3rd Series, Nos. 140, 153, 169, 184, 188, 202, 221.

18 B.R.S., 3rd Series, No. 209.

advantage that faces can be made so true and regular that plastering can be restricted to a skimming coat or even entirely omitted. Some of these slabs are internally reinforced with reeds, and this form may need to be excluded from buildings likely to harbour insects.

WOOD-WOOL SHEETS OR SLABS

This form of product, which has enjoyed considerable vogue on the Continent, is light, reasonably strong, forms a good key for plaster, and has insulating value. Its lightness and toughness enable it to be handled in bigger slabs than such comparable materials as clinker, pumice, clay or plaster slabs. It seems good as a sound-absorber, but not specially resistant to the passage of sound from one room to another. A good deal of the finished strength of a thin partition depends upon the hard plastering of both sides, and workmen new to this material are often alarmed by the apparently shaky condition of the work before plastering. The method of securing true verticality is to erect the slabs against temporary guides of strutted studding on one side, plastering the opposite side when complete, before removal of the studs. After plastering the reverse side the partition will be found marvellously stiffened.

GLAZED WALL TILING

Glazed wall tiling, which is fixed by plasterers to cement backing, is frequently found detached from the backing, even when it does not fall. B.R.S. state that their experiments have shown that adhesion can be considerably improved if the tiles (previously soaked in water, as usual) are coated at the back with a cement slurry of cream consistency 24 hours before fixing.[19] Complaints are, however, most frequent when tiles are fixed to breeze or clinker block partitions, and in this case are generally due to movements of the partition material due to shrinkage.[20]

CEILINGS

It is only necessary to glance through the issued "Notes from the Information Bureau of the B.R.S." to realise how constant are the inquiries and complaints as to the performance of plastered ceilings. It is, of course, in ceiling work, where the whole weight is dependent on the key of the plaster, that defects are most easily revealed and have the worst effects. As a superficial yard of plastered ceiling may weigh anything from about 70 lbs. upwards, any considerable fall is capable of inflicting damage or injury. For the causes and precautions relative to this danger, reference should be made to the preceding notes and to the fuller discussions indicated therein. Annoying, but less serious, defects which commonly arise are cracking due to slight structural settlements (such as result from timber shrinkage or movements of roof construction, and "pattern staining"). The former class is not directly attributable to the work of the plasterer; several points under "Bricklayer" and "Carpenter" are directed to safeguarding against such results. Pattern-staining, which may appear either as light lines on a dark ground or *vice versa*, is due to the deposit of dust on the plastered surface in uneven proportion according to the differing porosity or thermal resistance of the substance backed or unbacked by structural members. A useful summary was given in B.R.S. Notes No. 60, 2nd Series, and the subject is exhaustively treated in B.R. Bulletin No. 10, "The Prevention of Pattern Staining of Plasters," H.M. Stationery Office, 4d. net. It appears

19 B.R.S. Notes, No. 45, 2nd Series.
20 B.R.S. Notes, No. 240, 3rd Series.

that lime plaster, by its generally greater thickness and higher thermal resistance, is less subject to marking than is gypsum plaster.

Another not uncommon trouble with ceilings is the shelling-off of a skin coat of Keene's from its backing. This failure has been frequently reported on by B.R.S. and apparently results most often from actual defects in the material supplied (staleness or inadequate " accelerator ") or from its faulty manipulation. The most informative summary appears to be B.R.S. Note No. 140, 3rd Series.

SURFACE TEXTURE OF CEILINGS

The dead flat whiteness of the Victorian ceiling is a legacy not yet entirely liquidated. Its reflective quality is, of course, not without value, but has less importance since window-area has increased in proportion, and dull-coloured wallpapers and heavy hangings have fallen into disuse. The possible alternatives to the smooth ceiling destined to be whitened are either a finish having a natural texture or one which can be glossily painted. Surface ornament being out of fashion, texture in a ceiling is best attained by a grit-finished setting coat, variously called by plasterers " stucco " or " church finish." With care in execution and stern warnings that the actual plastered surface is to remain untouched and so must not be carelessly defaced, a beautiful texture and parchment-like colour with a suspicion of egg-shell gloss can be obtained by a lime and sand coat finished from the float and showing the sweeps of the workman's arm. The tendencies which must be guarded against are, on the one hand, effort by the plasterers to attain as smooth a finish as the method will allow, and, on the other, to proceed on the apparent belief that something resembling a Rugby field after a gruelling match is the aim, instead of the simple result of a coat laid easily and naturally.

It seems probable that the present ruthless exclusion of ornament is a phase which will pass. In such case the pleasant effect which can be gained at trifling cost by the introduction at corners of suitably modelled low relief fibrous plaster castings set in the plaster should not be forgotten (Fig. 115). These can be obtained for a few shillings apiece from well-known firms.

The ceiling finished in Keene's and painted is sometimes a pleasant thing, but it should not be forgotten that it calls for a high degree of accuracy in finish and *must not crack*; any defects are made woefully apparent by the glossy surface and no amount of " making good " will eradicate them.

Cornices are out of fashion, but coves (or " rounded angles " as the lady client calls them) are not. The cove by itself produces an amorphous effect and creates a problem—where does ceiling treatment end and wall begin? A much pleasanter effect is produced if the cove is given a narrow fillet top and bottom ($\frac{1}{8}$ in. is sufficient), and supported beneath by a plain flat fascia as shown in Fig. 115.

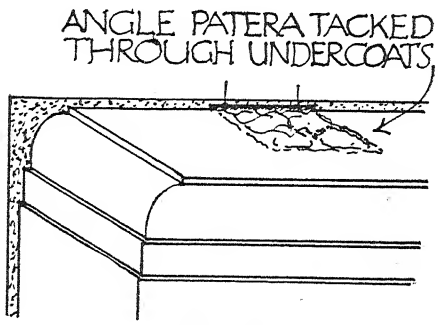


FIG. 115

Quirks or Rounded Angles. — The liability of salient corners in plaster to be chipped or damaged was at one time commonly countered by the use of staff-beads. More usually now " angles to be in Keene's on a Portland backing " is specified, but this course is unsatisfactory where a tex-

tured or distempered finish is proposed, as the different material has a wholly different surface, and affects both texture and colour. A better practice is to fix metal angle-beads to the bare brickwork (Fig. 116), to be buried in and serve as an angle-screed to the ordinary wall plaster.

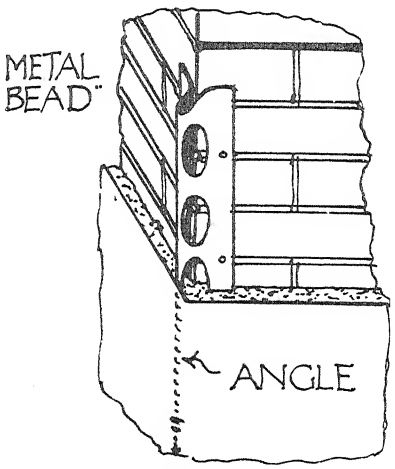


FIG. 116

WALLS AND PARTITIONS

Complaints as to wall plastering usually take two forms—over and above an occasional case of cracking or "popping" due to one or other of the causes already enumerated. The most serious of these (fortunately not common) is a tendency for the plastering to leave the wall in places, so that, even if it does not fall, bulges are evident, and the affected places give a hollow sound when struck. It appears to be established that this condition arises from the presence of magnesium sulphate in the brickwork, which in the presence of lime and moisture in the new plaster, crystallises on the interface between brick and plaster with sufficient force to push the latter off—or even to detach portions of the actual brick face. In some examples which have been seen quite a considerable bulk of glassy crystal has interposed between the wall and plastering. Certain types of brick seem particularly prone to contain a few specimens likely to produce this effect, which can cause great trouble. Both lime and Portland cement in plaster are liable to bring about this action in favourable conditions; the use of calcium sulphate plaster (gypsum) should avoid it.[21]

Condensation. — The second and much more frequent complaint relates to surface condensation or "sweating." It is sometimes difficult to persuade houseowners that this is a manifestation of the working of the laws of Nature, to which in certain circumstances any non-absorbent surface is liable, but a good many precautions can be taken to minimise the nuisance and reduce its frequency. The subject is fully discussed in B.R.S. Note, No. 229, 3rd Series, in which, briefly, the conclusions are that normal 11-in. cavity walls (with cavity *unventilated*), reasonable heating and ventilating provisions, and a porous surface treated with porous distemper, should secure reasonable freedom from this trouble, which in the case of hard plaster, painted walls, glazed papers, tiling or vitrolite can be quite serious, even to the extent of forming pools on floors and other horizontal surfaces.

As affecting the work of the plasterer, it will be found that by finishing walls with a grit finish in lime and sand, the streaming of moisture thereon during sudden rises of atmospheric temperature can be entirely avoided. In these conditions walls mark less readily and keep clean longer, despite their roughened surface. It may be thought troublesome at first that sand and dust is apt to detach itself from the walls and damage floors and carpets; but the rather friable surface is adequately fixed by the application of the usual distemper finish.

Making Good.—One of the most annoying features of housebuilding (a survival, presumably, of the days when wall-papering was almost invariable) is the carelessness with which

21 B.R.S. Notes, No. 43, 2nd Series.

plastered wall surfaces are apt to be treated by other workmen, who seem to assume that all marks can be covered and dents, grazes or holes effectively "made good." As a matter of fact, walls which are to be distempered can never be made good so that the original defect leaves no evidence; this is even more the case where a textural finish has been applied, such as the grit finish mentioned above. Whatever method is used for patching, the absorbency of the inserted portion is practically certain to differ from the surrounding work, with noticeable effect upon the result. For this reason it becomes essential for a good effect that such items as stoves and chimneypieces, cupboard fronts and similar fittings, staircases, recesses for switches, and holes for passage of pipes, should be fixed or completed and made good before the final coat of plaster is applied.

EXTERNAL WORK: GENERALLY

Whether in the form of rendering, roughcast, finecast, or textural finish involving a more complicated technique, the practice of coating the exterior of a house with a cemented face is one which has made great headway. In conjunction with cavity walling, as supplementary means of ensuring a weatherproof structure, an external coat of water-repellent plastering is harmless, or even beneficial, but to rely upon such a skin for the exclusion of driven rain (as many people apparently do) countless unfortunate experiences plainly show to be unduly optimistic. Thanks to the clear exposition of B.R.S.[22] the reasons are becoming better appreciated. They are, briefly—cement and sand rendering upon a base such as brickwork has a tendency to shrink in drying, producing a network of fine cracks through which moisture penetrates to the wall beneath. The brickwork becomes locally saturated, but evaporation outwards is prevented by the impervious coating, the cracks not affording opportunity for this process. Hence it penetrates the wall (if solid), and appears as dampness on the inner face. In the worst circumstances, repeated penetration in this way can also produce further trouble in the form of efflorescence of salts from the brickwork, which may progressively detach the rendering itself, or the internal plaster, large slabs of which may ultimately fall.

A lesser trouble which may arise from impervious surfaces (even if perfect in the foregoing sense) is the streaming of heavy rains down the wall face to saturate ground and footings beneath. A certain degree of surface porosity has "blotting paper" effect in protection against this result.

Yet another cause of disappointment sometimes (quite unreasonably) felt is from the tendency which self-coloured white or light-tinted renderings have to grow dingy and shabby with a few years' exposure to weather. It is only natural that they should require freshening up, as would any painted or distempered surface under like conditions; but many people appear to suppose that a white cement will ensure permanent whiteness.

ROUGHCAST

In roughcast, as in other details of craftsmanship, wisdom lies in avoidance of exaggeration of natural qualities—a dimpled rather than a rugged effect is usually most satisfactory. Old examples which have been many times limewashed give a guide to the best effects. As to execution, repeated experiment has brought the writer to the conclusion that cement and sand for the rendering coats, with a splatterdash surface of lime and pea-grit (with ochre added if a cream tint is desired), finishing "self-coloured," is the most generally successful method. The slightly absorbent surface has an

22 B.R.S. Notes, No. 29, 2nd Series; No. 151, 3rd Series.

equalising effect when saturation tends to occur, and appears to be least subject to washing off of the further coats of limewash or distemper which may be periodically necessary.

TEXTURAL FINISHES

These may vary from the ordinary method of floating a "stucco" surface with a felt-faced wood float to a wide variety of informal patterns produced by various orthodox or unorthodox tools, such as trowel, stable-broom, banister-brush, or "butter-stamps." Some very useful directions on various surfacing methods have been issued by the Cement and Concrete Association, whose skilled demonstrators are at the disposal of architects and builders, to show "how it's done." Some particularly effective treatments in "Cullamix" can be achieved by roughening the final coat with a brush, and quickly pressing it with a plasterer's trowel, so as to flatten the more prominent projections thus formed. This operation is best performed by two workmen as a team, closely following one another. A drawback to all such methods is the difficulty of disguising the junction between one level and the next, as each successive staging is reached during progress. This difficulty probably explains the custom prevalent in East Anglia when externally plastered houses were traditional, of dividing the patterned work into definite panels by flat screeds appearing as stiles and rails. To avoid visible joins needs constant attention to maintaining a broken line, and even the hacking off irregularly of portions of the edges of the last-completed tier. Matters are simplified if horizontal weatherings are formed at intervals, such as at the level of ground-floor window-heads, and these serve also a useful purpose in throwing off streaming rainfall. Builders appear to give themselves needless trouble, and to neglect a means of unifying effect, by failing to run these over-window weatherings continuously, preferring to form stopped ends to each window-head even when closely adjacent. It is both simpler in execution and better in effect if roughcast or plaster is dressed out over a line of 4 in. x 2 in., temporarily secured in position as a guide (Fig. 117), provided that care has been taken (as advised earlier in these notes) that the heads of openings line up horizontally.

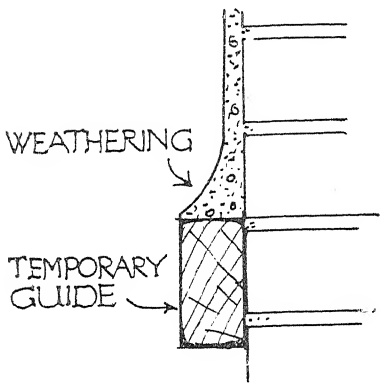


FIG. 117

WALL TILING

A glazed tile wall-lining is usually dealt with by the plasterer, though often it is more convenient if this work is executed by the bricklayer. Some general observations as to frequent causes of failure in adhesion have been given in the preliminary notes to this trade. On that point it may be worth while to repeat here that prolonged soaking (say overnight) and removal of tiles direct from a bucket of water for fixing are practically essential precautions. Other points worth mentioning are:

Bonding.—The attempt to lay tiles with joints broken or "bonded" generally results in a less satisfactory appearance than arises from a straightforward checker fashion of laying. The desire on the part of conscientious workmen to mask slight irregularities of line in the tiles they are using probably accounts for the preference so often shown (in default

of direct orders) for a bonded scheme of laying. This leads naturally to consideration of the next point.

Width of Joint. — Wall tiling is often advocated as a sanitary provision; as such it is dependent on the absence of crevices. It is a fact of general application that an open joint which has subsequently to be filled can more effectively be so done if it affords space than if the adjacent edges are virtually in contact. For this reason tiles set on the backing with open joints of $\frac{1}{4}$ in. and upwards probably give a surface with fewer crevices after the joints have been filled than those which have been close-set and subsequently jointed in customary fashion by rubbing in Keene's or similar plastering material. Moreover, the adoption of a visible joint serves the purpose of masking the trifling irregularities which arise in all fired objects, and (with colour of jointing carefully chosen in relation to the tiling) can add value to the colour effect of the whole and mitigate the "public lavatory" suggestion which a too aggressively glaring expanse of tiling inevitably produces.

Salient Angles.—External angles in glazed tiling are best avoided where possible. Any irregularities are there most accentuated, and the risk of damage is greatest. It is, however, inevitable that some cases must occur, and in these instances some form of rounded angle is practically always advisable and desired. A much less fidgety effect is attained in such cases if tiles actually rounded within their normal thickness are used, rather than if a relatively coarse separate "bullnose" strip-tile is applied (Fig. 118).

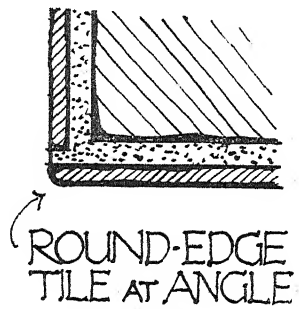


FIG. 118

Skirtings to Sinks, etc.—Wherever a tiled wall-lining occurs above a sink, or the dished top of a rectangular bath, care should be taken that tiling and backing overhang the rim rather than continue behind it (Fig. 119). The customary practice of filling the joint between tiling and pottery or iron with Keene's cement has nothing to recommend it. In frequent contact with water, the Keene's jointing soon becomes defective or missing. A preferable material in the circumstances is glazier's putty, which, if allowed to harden first, can be painted and has sufficient elasticity and resistance to water to remain unaffected and more reliable than the soluble Keene's.

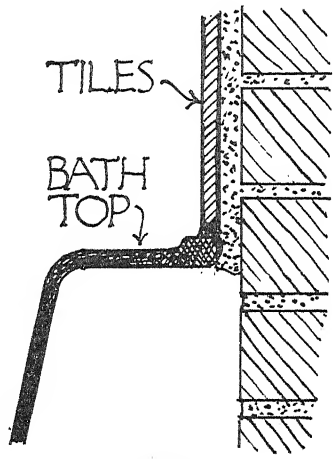


FIG. 119

Enamelled Hot-water-boiler Surrounds.—Some of the more presentable of the modern popular domestic hot-water boilers, which are customarily set in chimney openings, can be greatly improved in appearance and robbed of their somewhat forlorn and accidental look by the contrivance of tiled hob surrounds, as shown in Fig. 120, in which setting they are quite admissible in hall or dining-room, where they serve to maintain a room temperature without "raw edge." The brickwork and quarry "hob" on

a level with the boiler hot-plate should not make contact with the iron, but leave sufficient clearance for expansion, and the glazed tile lining above hob level (which also may be subject to temperature movements) should not be close-jointed.

Soundproofing. — Many people believe that the penetration of sound from one part of a house to another can be checked by some action of the plasterer, and to a limited extent this is true—it is, for instance, demonstrably the fact that in a house thinly plastered on lathing with two-coat hard plaster, such sounds as the click of a lock will be much more audible in the quietude of night than would be the case if thicker lime plaster or an absorbent wallboard had been used. Generally, however, avoidance of annoying noises must be sought further back—in segregation by planning, and by solidity of structure. It is possible to eliminate many of the sounds arising in a w.c. or bathroom, but some inevitably remain, so that their isolation by planning is the only sure resource if exclusion be desired. One has noticed in many recently published examples of "free-planned" modernist houses an unfortunate tendency to place baths and w.c.s over living-rooms and dining-rooms. This is asking for trouble. A good deal of attention has been paid to this matter lately, and in two recent notes from the Information Bureau of B.R.S. there is useful matter on the subject—Nos. 239 and 252 in Series 3, dealing respectively with w.c. noises and sound-absorption by plaster.

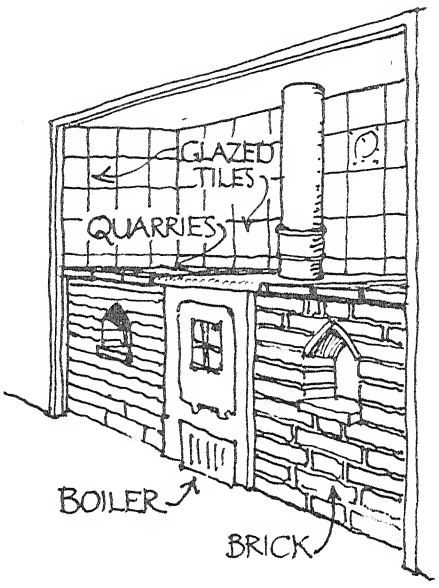


FIG. 120

PLUMBER

EXTERNAL

Materials and Generally.—Lead is one of the most accommodating of materials, and when rightly employed, one of the most reliable and permanent. The use of sheet lead for fashioning such details as flashings, soakers, aprons and weatherings, and for similar protective junctions between different planes and materials where slight movement may be expected, seems to be the most convenient method likely to be devised. It is a common practice for flashings and aprons which have to be tucked into brick joints to be pointed in cement mortar. This should be avoided, and any other contact between cement and lead in the presence of moisture. Serious corrosion is likely to arise, which may completely destroy the nature of the metal.[23] A lead apron in a prominent position such as overlying the tile-hung waist of a bay or at the margin of a flat-roofed door-canopy, can be pleasantly removed from bald sufficiency by a cut edge on some simple geometrical scheme such as Fig. 121.

Lead Burning.—When a rainwater-head or short length of box gutter is required to special dimensions, it is often more expeditious (and even less costly) to make this up of sheet lead than to procure a casting. The easy

FIG. 121

application of lead-burning technique has made this course comparatively simple under modern conditions, and the resource should not be lost sight of. By this method box forms are cut

[23] B.R.S. Notes No. 41, 2nd Series, and separate Bulletin.

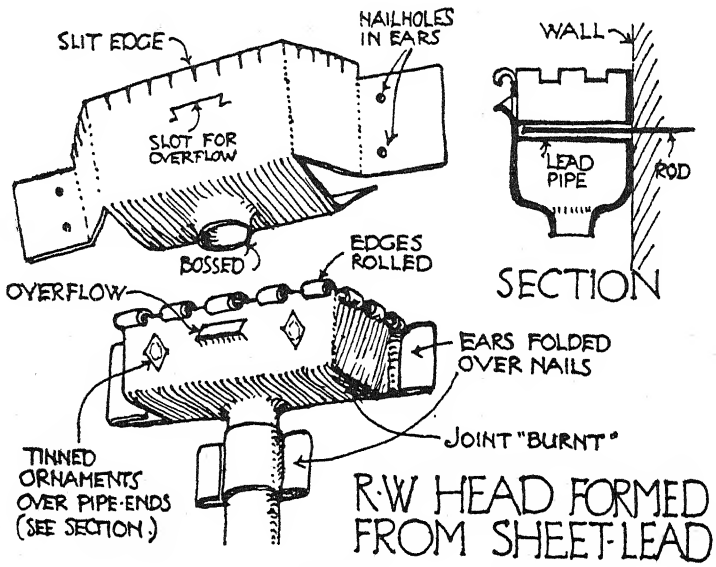


FIG. 122

out of flat sheet and bent to shape very much as a paper envelope is formed, the junctions being then "burnt" with a flame jet so as to melt to a solid join (Fig. 122).

Lead Soil and Vent Pipes.—Many houses having storeys in their roofs with gable or dormer windows are sadly disfigured by drain vents carried up externally to the prescribed height of 3 ft. above the nearest window head. Few sanitary authorities will object to such pipes (if in drawn lead) being taken through the eaves-soffit and thence below roof covering and between rafters to the necessary height, where emergence is made through a collared lead slate, showing only the wire-balloon. This treatment is relatively inconspicuous.

Lead soil, waste and ventilating pipes form the subject of two B.S.S.; No. 602 for ordinary lead, and No. 603 for the ternary alloy, which is tougher and more resistant to corrosion. Any pipe passing through brickwork should advisably be protected from the action of free lime by a wrapping of bituminised felt or some equally effective means.

Cast-Iron Rainwater Goods and Other Materials of Similar Use. — These are sometimes classed as plumbers' materials, but have already been dealt with under "Smith and Founder."

Cast-Iron (Coated) Soil, Waste and Ventilating Pipes.—These are covered by B.S.S. No. 416.

A word may be said against the objectionable but common practice of making lead bath and lavatory wastes discharge to a rainwater head—often immediately below a window. Such heads are liable to become very foul with decaying soapsuds and the like, and are not self-cleansing. A preferable practice is to terminate the iron waste pipe with a double Y junction (Fig. 123), taking the lead wastes loosely into the side arms and capping the centre socket with a wire balloon. This treatment makes the waste virtually self-cleansing and not so readily liable to blockage or overflow, and is quite neat in appearance —a matter of concern now that fitted basins occur so frequently in situations where their wastes are only too apparent.

It may also be worth remark that many builders appear to suppose that a bath or lavatory waste must (like a soil pipe) be taken by the shortest route to an exterior position, in which it is often unwelcome and very liable to freeze. If siphonage is provided against, it is permissible and often advantageous to run such pipes internally down to ground-floor level, at which point they can emerge to discharge over a gulley in the open.

EXTERNAL PIPES GENERALLY

Though the rhythmic placing of R.W.P. with dignified hopper-heads can often be effective in formal design, no one seems likely to claim that the appearance of any house is enhanced by the untidy sprawling of external piping, be it for soil, waste or rainwater collection. Yet many houses are built which exhibit such appurtenances in prominent positions. It is a grim reflection that in countries possessed of a climate subject to frosts so severe that these external pipes would fail in their functions if thus exposed, it is found quite possible to

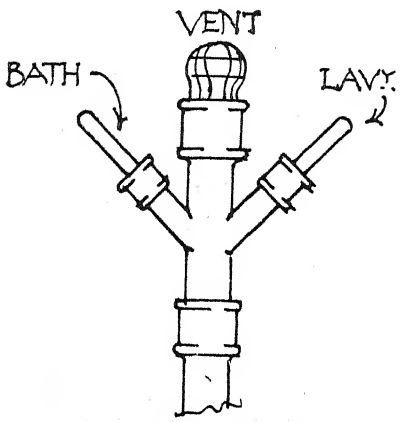


FIG. 123

seclude them; following which practice a specially high degree of proficiency in their treatment necessarily arises. So long as we remain compelled to give so great prominence to our pipes, however, it is idle to pretend (as many appear to do) that they have a certain quality of invisibility. As a general practice it might be considered advisable to draw carefully upon each elevation every such pipe which will appear, making each look as ugly as plain draughtsmanship can accomplish, in the certain expectation that the reality will be uglier still! Having done this in the early stages of the design, reconsideration may enable improvement to be effective by detailed replanning so as to dispose the necessary fittings in positions whence their pipes will emerge less conspicuously, or will reduce in number by the possibility of joint use. There are occasions when an otherwise good plan ought to be scrapped because of the impossibility of avoiding grossly unsightly exhibition of pipes.

INTERNAL PLUMBER AND HOT-WATER FITTER

GENERAL

The work of the internal plumber in the average house is mainly connected with water services (cold and hot) and with the installation of sanitary fittings and their connection to services and wastes. In each of these branches of work there have been important advances, chiefly, perhaps, in the direction of more presentable appearances, but also to some extent towards greater efficiency. As instances, such things as the substitution of neat copper tubing for lead or iron pipes, and the improved external form of waste-traps can be named. These changes have no doubt been brought about largely by the wider distribution of sanitary fittings (and with them water services) which no longer remain concentrated in scullery and bathroom, but invade bedrooms and kitchen—the latter now frequently the " show place " of the house.

MATERIALS

In deciding upon the material which should be employed for water services, it may be necessary to have regard to the quality of the water supply. So far as the underground connection to a service main is concerned, there are the available alternatives of heavy lead piping or galvanised steam tube. In soft water districts lead must be avoided; elsewhere it possesses many advantages from the main to the inlet to the storage cistern—the chief one being permanence. Inside the house, for distributive systems, the neatness and ease of installation of light-gauge copper tubing[24] in conjunction with either capillary-solder-ring jointing, or compression-joints, seems likely to make its use, sooner or later, universal. These pipes have none of the clumsiness of lead or iron; can be bent to any desired radius, avoiding the use of elbows or special bends; can (when required) be disconnected with ease; and do not impede the easy circulation of water.

CONNECTION WITH MAIN

Normally, the connection which is made to give a supply while building becomes eventually the permanent supply to the house, so that its position should be carefully chosen. It is customary and desirable to fit two stop valves on every main supply—one at or near the boundary of the premises being under the control of

24 B.S.S. 659, Lightgauge Copper Tubes.

the water authority, and the other, within and as near the point of entry to the house as possible, under control of the householder. It is a convenience and a safeguard if the latter is of the combined form embodying a draw-off cock by means of which the rising pipe can be drained of water when the house is unoccupied during times when frost may be expected. From the rising main a branch should be run to supply a draw-off tap for drinking water over the kitchen sink. Usually, all other services are drawn from the supply cistern.

Much greater care than seems usual should be given to the choice of a position for the rising main. It should not be on an external wall facing north or east, and if such a situation as adjacent to the boiler flue can be arranged, periods of frost can be faced with equanimity.

STORAGE CISTERNS

The domestic storage cistern is usually a galvanised mild steel open tank fixed in the roof space. It should conform to B.S.S. No. 417, and it is a mistake to restrict size to the smallest permissible. Nothing under 80 gallons can be considered adequate, even where " continuous supply " is expected. It is well to remember that unless all connections can be arranged and made prior to galvanising (which is very infrequently done), the cutting of apertures for inlets and outlets will inevitably destroy the protective coat of galvanising and permit corrosion to begin. It is usually found adjacent to such piercings. Considerable additional protection can be given to cold cisterns if, when all connections are complete, they are temporarily securely plugged from within, and the whole interior of the tank given a good thick coating of cement-wash.

BALL VALVE

The rudimentary practice of adjusting ball valves by bending the arm has nothing to commend it. There are types of fitting available in which the correct closing of the valve against varying pressure can be altered by a thumbscrew adjustment which changes the fulcrum of the lever (Fig. 124). The overflow or " warning pipe " from a cistern should be of ample size for its purpose—say at least four times the area of the service—and it should be disposed inconspicuously; a good place is by projection through the eaves soffit.

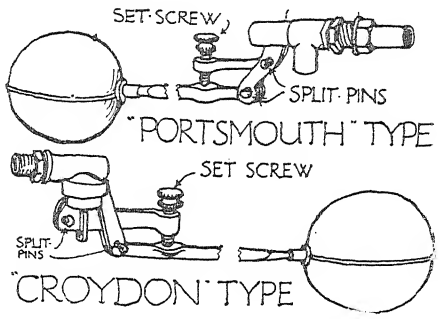


FIG. 124

OUTLETS

Each outlet should leave the cistern at a point at least 1½ in. above the bottom of the tank, so as to be clear of sediment. It should be controlled by a stop-valve directly from the tank, to which it should be joined by a back nut on the tail of the valve screwed on inside the cistern. By no other means can security against leakage from a burst pipe be made absolute. All distributing pipes in roof spaces or other inaccessible, and possibly draughty, positions should be wrapped in hair felt, and for this purpose the properly prepared felt made upon a canvas backing overlapping on one edge should be used. When spirally wound with this material, pipes are protected in a workmanlike manner.

SUPPLIES TO FITTINGS

The internal fittings, which may be called " standard " to the average

house, are sink, bath, lavatory basins and w.c. The selection of these may depend to a great extent upon the prospective owner or occupant, but there are points upon which influence may be directed, either in planning or in guidance to a wise choice.

Sink.—Reference has already been made to points relative to the placing of the kitchen or scullery sink. As regards the position and fixing of supplies, several important points arise. Except where a supplementary soft-water tap is required, there seems no reason why more than two draw-offs—cold from the main and hot from the domestic supply—should be fitted; but their position and projection are vital to convenience in use. The worst possible placing is centrally over the sink with bold projection; this inevitably results in constant breakages of china. Positions towards the corners of the sink, but not so close as to prevent the placing of a pail beneath them, leave the central area free, and give maximum convenience (Fig. 125). Height is also subject to a similar rule: it should allow a pail to be placed easily beneath the outlet, but should not be much greater than this, or splashing will be increased.

Fixing needs more care than it often receives. If a lead pipe is the base, the constant use of force in tap-closing tends gradually to distort the angle of the projecting tap towards the left. Copper tubing (unless a back-plate fitting is used) gives little better support. Unless the luxury of special chromium-plated combination fittings can be afforded, the best resource seems to be the junction of both cold and hot services to a length of screwed iron barrel having tees to which the bibcocks are screwed, the intervening length of barrel between the taps being blocked (Fig. 126). This method has the further advantage (beyond firm fixing) that it can be employed where a window occurs immediately behind the sink, the barrel-rail upon which the taps depend being carried boldly across the opening.

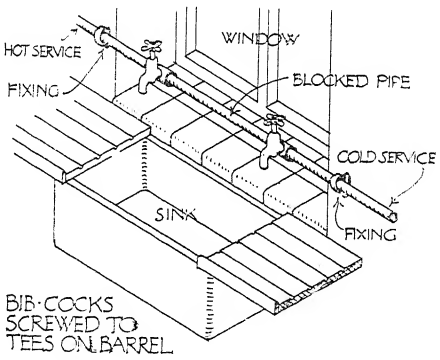


FIG. 126

Incidentally, an excellent fixing for a single draw-off tap may be made by the use of a tee instead of an elbow, the backward arm of the tee (Fig.

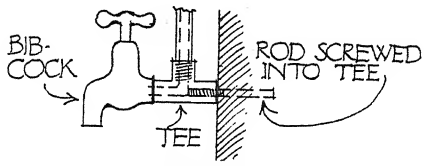


FIG. 127

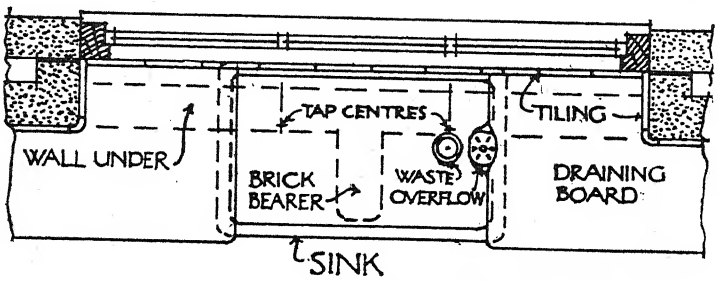


FIG. 125

127) having a rod screwed in and pinned into the wall behind.

Bath.—The connection of bath supplies calls for little comment except perhaps that by scheming it is often possible to utilise the hot service pipe as a convenient towel rail along the side of the bath. The almost invariable use of enclosed types of bath, with hidden services, makes it necessary to remember that wherever there are pipes access to them may some day be desired; also that a waste trap of a form which will neither unduly raise the bath, nor restrict the possible depth of seal while still permitting access to the clearing plug (which must accordingly have a side outlet) is a vital necessity. Such a type as that shown in Fig. 128 fulfils the needs.

Lavatory Basins.—A good deal can be said upon these fittings and their appurtenances. It took makers about 40 years to realise that the best place for the hot and cold taps was at the sides, and not in the centre of the rear of the basin, and there are points as to soap-trays, overflows and lodgement for trinkets which seem not to be generally recognised yet! In the last few years, however, there has been manifest improvement in this respect, and also in the external form of basins commonly obtainable.

Apart from such details as size, material and fittings, choice usually centres on methods of support, which may be by brackets, pedestal, frame with legs, or cabinet. Of these the alternatives of simple brackets, or enclosing cabinet seem the most generally practical—the former supports the basin directly from the walls, without interference with any desired floor covering; the latter fulfils a useful purpose in concealing the details of supplies and waste and affording some space for the accessories which are sometimes desired. Pedestal supports are apt to appear more attractive in showrooms than when fitted; they complicate the matter of floor coverings and do not usually conceal plumbers' pipes. If a cabinet is used, the need to provide toe space, as previously mentioned, should not be overlooked. Where the waste-trap is necessarily exposed a sightly type should be chosen. The "bottle" shape seems preferable, and a re-sealing design, such as "Seltite," has manifest advantages.

A splash-back wider than the basin, a shelf for toilet necessaries, and a stout hook for the attachment of a razor strop should form part of the equipment for every bedroom wash-basin. The arrangement regularly installed in the hotels of Trust Houses, Ltd., is ideal (Fig. 129).

W.C.s.—The common, and sometimes unavoidable, practice of placing w.c. windows behind the fitting is by no means the best; a window in a side wall, leaving the space behind free for flush-tank and pipe, is to be preferred. The popular "low-down" type of flush tank no doubt looks

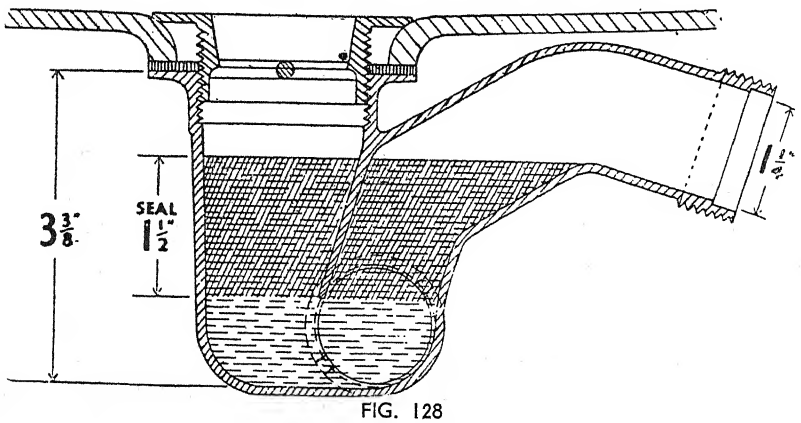


FIG. 128

better than the elevated type, and is in most cases quieter in use, but it is less forceful. Silent types of flush tank are obtainable if sought, and noise from this source is worth some effort towards elimination. The sounds to be guarded against are: (1) mechanical noise of operation; (2) gurgle of emptying; (3) trickle of refilling; (4) hissing of water pressure. A good piston-action syphon, with provision for incomplete emptying and a tube drop from the ball valve, the latter connected to a low-pressure service and correctly adjusted, can be virtually silent. A wooden lead-lined flush-tank, with all interior fittings in rustless metal, is advisable in many soft water districts, and gives practically no trouble. In some districts it is permissible to use automatic flushing valves generally of a type similar to those usual in America, which are very efficient.

The junction of flush pipe to pan is still often formed by red lead and canvas with twine or wire binding. There are several types of special fitting which give a much smarter connection by means of screw fittings and rubber washers or soft lead collars.

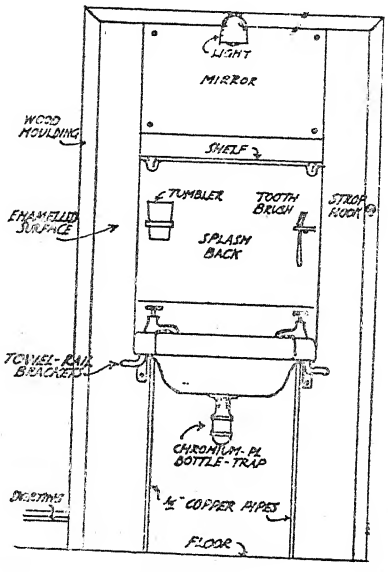


FIG. 129

HOT-WATER FITTER

In some soft water districts, and elsewhere often from preference, it may be desired that all components of domestic hot-water and heating systems should be rustproof, in which case copper pipes and cylinder will be employed. More usually, however, galvanised iron is the material for pipes, fittings and tank or cylinder, and though no general scheme for a complete installation can be suggested in these notes, a few detailed points, which can with benefit be observed, may be mentioned.

Right-angle changes in direction should, of course, be restricted in number to the utmost possible extent. Where obligatory, square elbows should be rejected, and round elbows used only where a longer sweep is impossible. Both types of fitting are governed by B.S.S. No. 154 for the ordinary type and No. 143 for long-sweep patterns, both in malleable iron. Pipe-bends formed from straight tube by the fitter will be deprived of their protective galvanising in the process; special bends, galvanised in their final shape, should be used.

Tank or Cylinder and Connections.—Galvanised mild-steel hot-water tanks and cylinders are covered by B.S.S. 417. With the orthodox methods of connection it should be remembered that it is the pressure of cold water entering which drives the hot water to the various taps, and the cold supply pipe should be of ample size to secure a good flow if more than one draw-off is being operated simultaneously. It is the general (and correct) practice to introduce cold replacement near the bottom of the tank or cylinder, and with the idea of preventing backflow of hot water along the cold pipe a siphon dip is often recommended just before entry. This is a dangerous and useless practice; backflow seldom occurs, but the dip may very readily become blocked by scale or silt, causing the flow to be restricted or, at the worst,

stopped. Single tanks and cylinders are usually supplied with four standard flanges, arranged alternatively on three systems for connection of flow, return, cold feed, and expansion—the latter, of course, serving also as draw-off. By one arrangement the cold feed enters at the side near the bottom, and where this is convenient no precaution against cold water boring through hot to the draw-off is needed. Where, however, the cold feed must enter the bottom from beneath, a " spreader " in the form of an internal tee (Fig. 130) should be fitted; otherwise the hottest water is quickly diluted by cold replacement entering with an upward impetus. A manhole is necessary to insert this fitting.

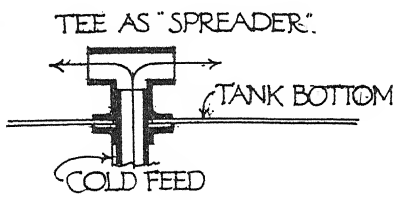


FIG. 130

A cylinder is more resistant to head pressure than a rectangular tank of equal gauge metal, test pressures applied commonly being in the ratio of 5 lb., or 10 ft. head for a ⅛-in. plate tank or a 16-gauge cylinder.

One trouble which has in the past proved very puzzling—the rapid corrosion and pitting found to occur in the neighbourhood of pipe connections—has been attributed more lately to an obscure electrolytic action supposed to be due to virtual insulation of the iron or copper piping from the cistern by the hemp or similar packing which is a component of this joint. It has been recommended that a length of tinned copper wire should be wrapped round each pipe entering the tank, with a full solder joint each end to ensure full electrical contact, as shown in Fig. 131, from a leaflet issued by the Builders' Materials Central Committee.

Auxiliary Heating of Water.—The possibilities of supplementing or substituting the ordinary source of heat by one or more electrical immersion heaters, or tank belts, for use when the domestic boiler is not welcome, should not be overlooked. Where such a course is proposed, and in most other circumstances also, the provision of an insulating jacket to the tank or cylinder will effect great economy of fuel or current; or, conversely, result in hotter water being available with less diffusion of heat from the storage vessel.

HEATING

There are still many people (probably a majority) in this country who find a thorough-going domestic central-heating plant distasteful, but will not reject what may be called auxiliary heating from the domestic supply boiler. There are several reasons which may make this provision desirable.

Radiators. — A domestic boiler which it is intended should burn continuously cannot be trusted to run through the night for an interval of perhaps ten hours without stoking unless it is equipped with a rather

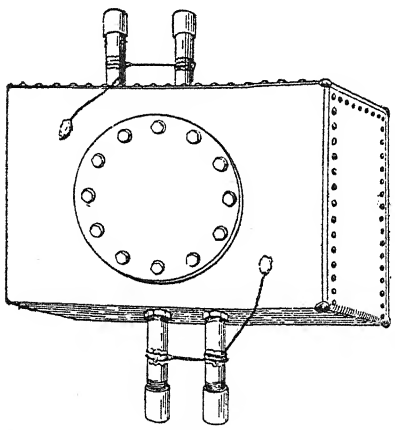


FIG. 131

larger firepot than the actual needs of hot-water supply ordain. Ordinarily, the additional size thus dictated will enable it to heat a few radiators sufficiently to take the chill off indoor temperature, particularly the early morning temperatures which in the unheated house are so discouraging to breakfast cheerfulness. In periods of extreme cold, such radiators when existent can be boosted to do more than that, but under ordinary temperate winter conditions they can be treated as a sideline, and forgotten—except for the pleasant result before mentioned. In summer-time, if the system is so designed that the complete radiator circuit can be cut out by a stop-valve, without interruption of the domestic circulation, the boiler, relieved of this call upon it and itself not welcome as a source of heat, can generally be relied upon to perform its remaining functions under night conditions—banked so that it need only be stoked twice daily, say, at 8 a.m. and 10 p.m.

Positions where the suggested supplementary radiators can most usefully be placed are the dining-room, hall, landing, and possibly a north-east bedroom. To serve this arrangement efficiently it will generally prove advisable to work on the indirect system with a dual cylinder, which should make first call on the main circulation, and to feed the radiators off drop-pipes, using the roof spaces for distribution, as shown diagrammatically in Fig. 132. Greatly improved efficiency is secured if the main flow and return, and any pipes not usefully employed in heating, are coated with non-conducting material, including, of course, pipes in roof spaces and any below floors. By planning with this system in view, however, it is often possible to dispense with underfloor returns, such as are necessitated where doorways interrupt the run back to the boiler.

Boilers.—With so many and various types of domestic boilers available, it is impossible in any one make to secure all the good points. There are a few which should always be sought, which may be given broadly as:—

(1) Maximum enclosure of firebox within water space, which serves the dual purpose of utilising the heat generated to best advantage and minimising risk of overheating;

(2) waterways carried well below grate-level, so as to form a pocket for sediment, prolonging the life of the boiler;

(3) no air pockets liable to produce weird noises in the system and to result in burnt-out plates;

(4) ample and *easily accessible* mudholes for cleaning;

(5) simple and convenient feeding door or lid which will not lead to annoying spilling of fuel;

(6) close air control with simple regulation;

(7) a rocking grate or similar means of shaking the fire while completely closed in, so as to minimise diffusion of dust. Some types of boiler have excellent devices for mechanically breaking up clinker which forms on the firebars at high temperatures;

(8) to the foregoing points most housewives now add an enamel finish, which can be kept clean. Some also stipulate for mica panels to display the fire.

Both these provisions are apt to be quickly damaged by accidental overheating, which is particularly fierce in its effect on the door covering the fire-front.

The domestic hot-water boiler has recently been under consideration by a committee of B.S.I., with a view to the issue of a Standard Specification based on performance. Some of the output figures issued by makers tend to be optimistic. This has appeared since these notes were written. B.S.S. No. 758, Part I, deals with rating, fuel capacity and heating surface, and Part II with testing methods to prove compliance with rating as defined by Part I. There is also a B.S.S. (No. 41) dealing with cast-iron flue or smoke pipes.

Expansion Tank.—The adoption of a dual cylinder and indirect system

necessitates separate cold feeds, that intended to replenish evaporation from the primary system being supplied from a feed and expansion tank fed by ball valve from the storage cistern. The water level of this

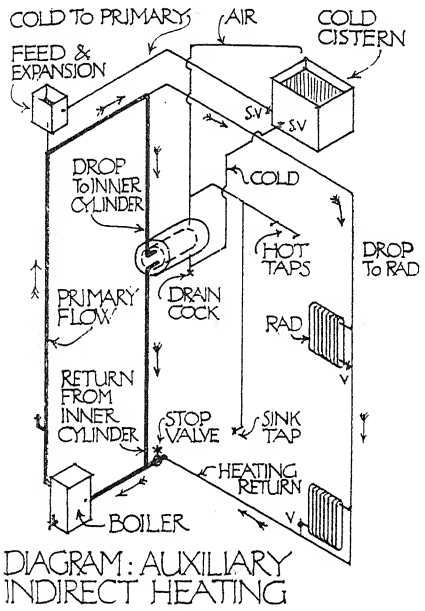


FIG. 132

tank should be set low, giving space for the increase in volume of roughly one-twentieth which will result when the contents of the primary system (boiler and piping) are heated from cold to working temperature. If connection to this tank is arranged as in Fig. 132 this must be the highest point of the system, the branch distributor to radiators having a perceptible fall away from the top of the flow-pipe.

Secondary Circuit. — With relatively short branches from the air-pipe to hot taps as shown, the disadvantages of a secondary return outweigh the benefits, unless a heated towel rail is required, in which case it becomes essential. If provided, some form of insulation against heat loss is desirable, for the double reason that the temperature of the stored hot supply may be materially lowered by the circulating water, and that unwanted warmth will be given off in summer when this circuit will still be in use, unlike the heating circuit which will be shut off.

Branch supplies without a secondary return, of course, necessitate emptying the pipes of dead water before hot begins to flow, but this is not usually an inconvenience with small pipes and short branches, when the quantity thus run off is sometimes barely sufficient to prevent risk of scalding.

Special Fittings.—Detail improvements in the design (internal and external) of hot water accessories are so continuous and frequent that a close acquaintance with the latest issued lists of specialist firms is vitally important if the best results are to be attained. Compare such items as radiator-valves or air-cocks now in current production with those of, say, ten years ago.

Gas-heated Hot Water. — Multipoint gas heaters as a means of the general supply of domestic hot water form a useful alternative to the independent boiler, and could often be adopted with advantage. It should, however, not be forgotten that unless skilfully arranged for, pipe connections to these, and the essential vent flue and outlet, may render the installation less sightly than is customarily the case in the gas company's showroom. Like other fittings involving pipe connections and flues, they should be planned for and not pushed in as an afterthought.

Electrical Water Heating.—Apparatus takes broadly two forms: the rapid-heating form using much current for a short time to heat water as required, and the storage form using a moderate amount of current more or less continuously to heat up a sufficient bulk of water to serve likely immediate needs. The first-named type is apt to be unpopular with supply authorities for obvious reasons; the second, in conjunction with effective heat-insulation and

thermostatic reduction of current-consumption when the water stands at the regulated temperature, is generally preferable. Electrical water-heaters have the advantage of needing no flues for combustion-products and much less obtrusive pipe-work; they can thus often be installed where other forms of heater would be practically impossible, which may reconcile users to their somewhat higher cost of running.

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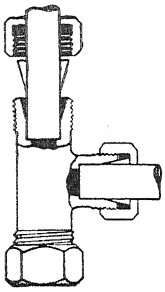

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GLAZIER

MATERIALS AND GENERALLY

As regards domestic work, the materials of the glazier are usually only clear or obscured glass and putty, but even in this limited field there is room for the exercise of judgment. One of the commonest of minor defects which has been prevalent since the wide adoption of metal windows has been failure of putties to harden. It does not seem to be generally realised that ordinary glazier's putty of whiting and linseed oil depends for its hardening partly on absorption of the oily constituent by porous woodwork and partly on oxidation by contact with air. Metal frames, of course, do nothing to extract the oil, and when (as is usual) the windows are painted as soon as they have been glazed, oxidation is checked and putties remain soft—sometimes to the point of drooping. Various remedies have been proposed, such as the addition of driers or the use of putty composed of red and white lead, but the best course is probably the use of a special putty, such as "Ferroput," prepared for glazing metal windows.

Sheet glass, formerly prepared by flattening out glass first made in cylindrical form, is now also obtainable in the form of drawn sheet, which can be employed with results (in the direction of freedom from distortion) nearly equal to polished plate. When ordering this type of glass, care should be taken to specify clearly which is the vertical dimension of the sheet, as the glass has "grain" which should be placed horizontally if distortion is to be avoided.

Crown glass is still used in some forms of lead glazing, and even the "bullions" or centres are sometimes asked for, to be introduced as features. A warning is necessary, never to use these on south exposures, as they can act dangerously as burning-glasses, which may ignite curtains or fabrics.

Obscured glass is now available in a wide variety of types, including some which may be usefully employed for special purposes—e.g., "Thermolux." For ordinary use, the most effective forms seem to be pin-point Morocco, which gives on test the highest degree of obscuration combined with the least obstruction to light; and crystal Flemish, which has a bold and brilliant appearance, and is easily kept clean. Many patterns afford too great a lodgment for dirt in the surface irregularities—including the one-time popular Muranese.

Leaded lights are still not entirely out of favour, and the adoption of steel-cored cames has removed one disadvantage which formerly attached to their use—the necessity for iron staybars with copper-wire binding to stiffen the lights. These rendered window-cleaning most troublesome, and even dangerous from the liability for the ends of twisted wire to inflict nasty scratches. By the use of flat, steel-cored cames cleaning is made simple, and a window can be treated very much as though each panel were a single sheet.

Putty.—Linseed oil putty is the subject of B.S.S. No. 544. Putty for metal windows has already been discussed. When glazing metal windows care should be exercised to see that the stubs or wire clips which the maker will supply are fitted, as these will be hidden by puttying when done, in the same way as will the sprigs customarily used when glazing to wood frames. (Fig. 133.)

Glazing Roofs or Skylights. — The advantages of using one or other of the special forms of puttyless glazing embodying lead-clothed bars with pro-

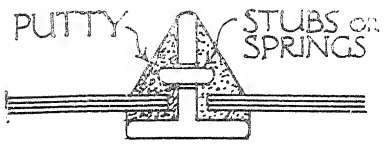

FIG. 133

vision for condensed moisture and even bedding of glass on asbestos cord should not be overlooked in cases where top-lights cannot be avoided over domestic interiors. These, and the cast-glass dome-lights already mentioned are the only forms which can be relied upon as unlikely to cause trouble.

For the glazing of external covered spaces or glasshouses, where wooden glazing bars may conceivably be used, the most recent practice is to omit entirely the top-putties, which are found to encourage decay in the woodwork by becoming partly detached and so forming water-holding crevices. By this method, now generally employed in commercial glasshouses, ample back putties are used, so that as the glass is pressed home, putty squeezes above its surface. It is then trimmed off level with the glazing, after which the upstanding portion of the wood bar, the putty, and the glass face for at least half inch each side is liberally painted (Fig. 134).

The desirability of snowguards at the eaves of any roof above a glass lean-to must not be forgotten.

Decorative Uses of Glass.—Mirror-glass, since the process of silvering became well known, has always been a favourite material for the decorator; but the possibilities of some recently introduced forms are as yet incompletely realised by many. The convenience with which such a material as "Vitroflex," consisting of relatively small rectangular pieces of mirror fixed by adhesive to a waterproof and flexible backing, can be applied to curved surfaces opens up a decorative field which should widen.

Proportionate Window Area.—It is not the glazier's function to determine this, but a few remarks as to necessities and excesses may perhaps be inserted here. Under favourable weather conditions, and with a pleasant outlook available, almost every healthy person will enjoy maximum window-space. But it is necessary to provide also for other conditions, and also to have regard for the fact that glass requires cleaning; no one admires large areas of smeary or rain-streaked glass. Objection to the "glasshouse" type of design seems to have been mainly concentrated on the fancied liability of such buildings to be chilly when the external temperature is low; and if no measures are taken, this may, of course, be the case. But artificial warmth is relatively easy to produce and maintain, if the cost is not objected to, whereas the problem of cooling such interiors in a heat-wave is far more difficult.

There is another aspect of this question which is most distasteful, but impossible to ignore. People who recollect the European War will remember that the dropping of relatively small bombs in a neighbourhood resulted in the wholesale destruction of all windows within range of the concussion. They may also remember that a high proportion of the injuries inflicted by the Halifax (Nova Scotia) explosion arose from flying fragments of glass like daggers. In any future war we

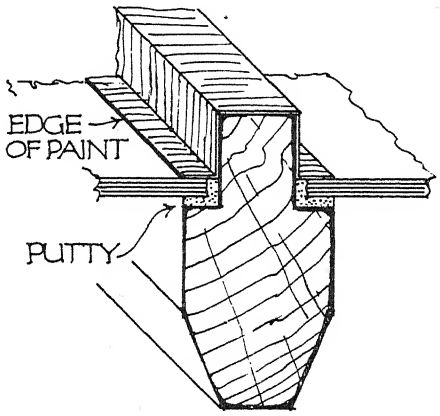

FIG. 134

are promised both high explosives and gas, which would undoubtedly be delivered in mixed lots. Who would like the task of making gas-proof even one room of a house largely enclosed in glass?

It is absurd—even disgusting—that such matters should have to be taken into account; but a Norman castle would be a better dwelling than the most advanced modernist house in the circumstances which we all hope may never arise. Meanwhile, it may be wise to include at least one room with sufficient degree of solid enclosure to make it practicable for gas-tight conditions to be contrived, and in the process it would automatically become less subject to the danger of flying glass daggers.

PAINTER

MATERIALS AND GENERALLY

A rudimentary fact regarding the purpose of painting which often seems to be overlooked is that it may have two distinct objects—the one protective, but the second transformative; only so can the frequent use of unsuitable colours for items of painted work be explained. Examples of misguided procedure can be seen on every side; for example, it is perhaps intended that in a cream-washed house the general scheme should be that all woodwork of windows shall be externally painted peacock-blue, while external ironwork (principally gutters and downpipes) shall be made inconspicuous by painting them a light grey. This idea is embodied in a general direction, "All external woodwork usually painted to be . . .; all external ironwork to be. . . ." There happens to be a roof finish consisting of fascia and soffit which gets painted peacock-blue regardless of the fact that it is properly part of the wall and would be much better in cream—both for general effect and for light reflection. There are also "spots" of metalwork such as air-bricks or soot-doors, which are accentuated by the same painting as gutters and pipes, whereas a moment's thought would show that these also ought to be treated as part of the wall surface, and not made conspicuous.

Painting materials, considered as preservatives, are so important to engineering structures on which expenditure upon maintenance can be very heavy, that (as in other instances where architectural and engineering needs run parallel) almost all common components are defined by B.S.S. No less than 71 B.S.S., at the time of writing, cover painting materials, and a general specification reference stating that all materials used are to comply with the latest appropriate B.S.S. which is applicable will bring practically every component in ordinary use (excluding, of course, proprietary articles) under control.

Priming and preparatory work. — Specifications frequently say "Knot, stop, prime and paint" so many coats; the right order is "Knot, prime, stop, etc." The adhesion of stopping is more certain if priming is first performed. The priming coat on wood or iron is of the first importance, and it is *not* wise to permit this to be done with any nondescript mixture—sometimes the tail-ends of several unused lots of paint mixed together.[25] The merits of aluminium paint as a primer for new woodwork have yet to be generally realised. By its nature and composition it tends to seal the substance upon which it is laid in an impermeable coat of scales formed by the minute leaves of foil which it contains, and moreover it affords an excellent key to succeeding coats.

Observant Londoners will from time to time have noticed the railings and other ironwork of our Royal Parks standing out temporarily in brilliant yellow during a stage in their periodic repainting. This is not just a fancy of some eccentric supervisor, or even primarily mere compliance with that excellent rule which makes each succeeding coat in a series so strikingly different from its preceding and following one that completeness is assured. Rust is held to be largely due to galvanic action, and the actual pigment in a paint can have considerable influence in encouraging or inhibiting it. Zinc chromate is one which has an inhibitive effect.

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25 B.R.S. Notes, 3rd Series, No. 238.

Painting on plasterwork.—Impatience in applying finishing treatment to walls and ceilings before a reasonable chance of permanence exists is the cause of most of the later complaints and heartburnings. If a new house must be too soon occupied, the best course is for plaster surfaces which are to be painted or distempered to be given coats of ordinary water-bound distemper, which does not seal the pores and can be washed off to permit the permanent finish to be applied at the first redecoration. By this method moisture and possible efflorescence of salts from the walls or plaster will be enabled to escape to the surface without harm. A great number of the troubles reported to B.R.S. might be avoided by this course.[26]

External distempering. — External colour-washing, if executed with distemper which contains casein or glue, involves some risk of unsightly growths of fungal or other organic nature. Once started, such disfigurements are difficult to prevent.[27] Limewash, coloured with earthy pigments such as ochres or sienna, are not generally affected in this way, though they may, of course, develop green stain from a leaky pipe or similar cause, as will almost any porous surface.

Wood preservatives.—The advantage of paint over preservative stains for use on externally exposed joinery (not carpentry or fencing) lies in the fact that paint is a film—a protective membrane acting similarly to the human epidermis. So long as this film remains unbroken moisture is excluded, whereas no saturating solution, unless it fully loads and clogs all open pores, can exclude it so effectively, and in most cases joints and crevices of joinery are exposed to penetration by shrinkage. The old custom of putting together all mortice-and-tenon joints in paint is a sound one. Another matter affecting oily stains, such as creosote, which should be borne in mind is their propensity to spread to adjacent substances—for example, wall-boards or plaster.[28] If the creosoted woodwork is not exposed, but hidden framework, liability for stain to " bleed " can be avoided by giving two coats of aluminium paint, which also forms a useful primer for stained work later required to be painted.

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26 B.R.S. Notes, 1st Series, No. 120; 2nd Series, Nos. 78 and 117; 3rd Series, Nos. 234 and 241.

27 B.R.S. Notes, 3rd Series, No. 231.

28 B.R.S. Notes, 2nd Series, Nos. 33 and 91.

PROVISIONAL SUMS

GENERAL

The habit of including p.c. sums in a specification for work which is to be submitted for tendering is one which has grown rather out of bounds, so that in many cases where (nominally) competitive prices are received, actual freedom to the tendering firms may be restricted to some 40 per cent. only of the total work; competition is thus illusory.

This is an age of specialists, and it is of course to the specialist that the provisional sum is chiefly due. There are manifest advantages in the employment of specialists for definitely expert work, and also for preserving to the client or his architect full freedom of choice as regards such fittings as must be selected from stock. It is to the latter class of " provision " that the money sums included in a specification for domestic work usually relate, and these in themselves daily become more numerous—at one time stoves and sanitary fittings were the only items commonly covered; now many varieties of electrical apparatus, refrigerators, water softeners, heating plant, fans, radio sets, fire appliances, and possibly acoustic plastering and air-conditioning clamour for inclusion.

The list of specialists' provisional sums suggested in B.S. Sequence of Trade Headings is much more extensive, but many of the items have not at present found their way into domestic practice. It is difficult to treat in any way likely to be helpful the various fittings available for use in the ordinary house, without instituting harmful comparisons, and possibly committing injustice to makers whose fittings may be unfamiliar, and hence overlooked or treated with incomplete realisation of their merits. But these sections cannot be entirely neglected, and the following notes will endeavour to deal with matters to which attention should be directed when making choice or arranging installation details.

METAL WINDOWS

One of the happiest moves of immediate post-war days was the agreement by which makers of domestic metal casements standardised dimensions and practice to decent proportions such as an architect can employ with satisfaction. Unfortunately there has been some tendency of late for alternative types, reproducing the unpleasant proportions popular with the speculative builder to be included, so that the salvation which many " unarchitected " houses have gained from the use of standard cottage casements is no longer certain. The original standard types—with or without glazing bars—are much to be preferred. They were devised with an obvious eye on 8-ft. storeys, and by wise selection can be made to fit practically every necessary circumstance.

Liability to rust, particularly along the bottom rail, is the chief drawback to the steel casement, and this point wants watching, so that rust is checked by painting before it has time to get hold. In seaside situations the precautionary measure of Sherardising is well worth its extra cost.

Painting metal casements is a ticklish business if a neat finish is to be made on the edges of sash bars—much more delicate a job than painting wooden bars. Some builders have even declared that the reduction of this operation which follows the use of plain casements and lead glazing will compensate for the increased cost of the glazing; certainly it will on successive repaints.

The type of staybar used is of importance, particularly in windy districts, where a flapping curtain quite readily unhooks the ordinary peg stay and leaves open casements banging. In such districts some form of sliding stay which cannot come loose is advisable, and most makers provide this on request. The two-point fastener and " easy-cleaning " hinge mounting are now, of course, commonplace.

A point as to the hinging of French casements which should have attention is the ability for them to be folded back flat against external walls when open, and fixings for cabin hooks in this position; otherwise loggias and balconies may be rendered practically unusable.

The utility of wood surrounds has been mentioned earlier on page 35; a parallel device, which combines also the advantage of closing the cavity all round a window, is the metal subframe shown in Fig. 135. This is a thoroughly neat and workmanlike finish.

When arranging grouped casements made up by combination of standard units, some thought should be given to the exigencies of curtaining and also to the desirability of an unobstructed centre to any window in which it may possibly be contrived. In practice, a five-light window consisting of a central three-light unit with a single fixed light on either hand is a convenient arrangement which permits open windows without disturbance of curtains (Fig. 136). It is, of course, wise to have regard to the direction of the prevailing wind (particularly the *west* wind) when arranging opening lights. In a two-light casement with one light hinged, this should always open against the wind. The practice of combining separate small windows by continuous head and cill with blank panels may do much to pull together a scrappy design (Fig. 137), and the device shown in Fig. 138, by which a partition can terminate against a thin mullion will serve to allow fidgety single windows to be avoided.

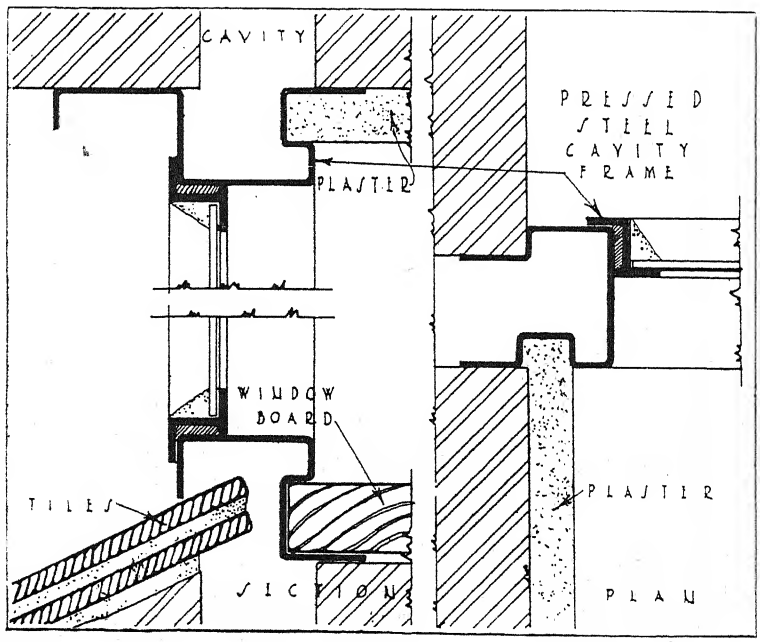


FIG. 135

ELECTRICAL WORK

Electrical work is essentially a specialist's job, and by specialist it is not intended to include either the showroom fittings-salesman or the small rural garage proprietor, both of whom sometimes aspire to advise or perform as electrical experts in competition with reputable firms.

So far as the architect is concerned, he will do well to depute details of installations to people whose business it is to understand the principles involved and to apply them; but he will of course retain his co-ordinating function as to visual design, placing of points, and quality of workmanship in such matters as he is able to judge —for instance, the pattern and form of lighting and other fittings, the situation and scheme of illumination (ceiling points, wall points, general or focal lighting), and the accurate centralisation, spacing or verticality of details, are things in which he should decide. Electricians are notoriously careless as to the last-named matters, so that central positions " off-centre," intendedly even spacings which are irregular, and upright arrangements with annoying inclination should always be looked for. Most of the components and accessories of a normal electrical installation have been made the subject of B.S.S., the list embracing 25 specifications at time of writing, but subject to frequent additions.

Apart from these aspects, there are points on general installation which architects should watch in the interests of the work, and a series of brief notes may be of some service.

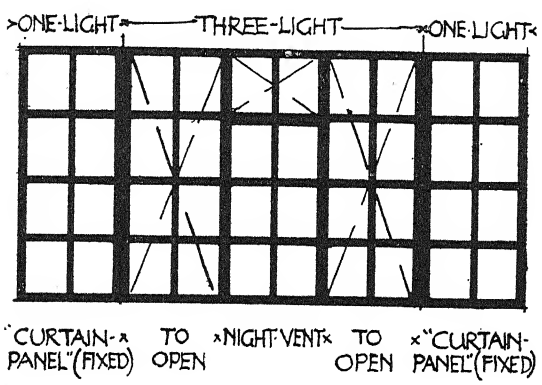


FIG. 136

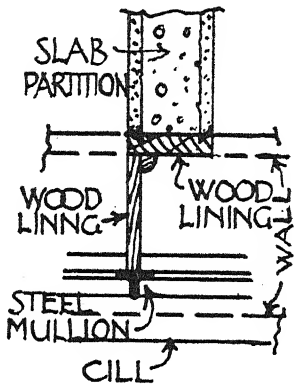


FIG. 138

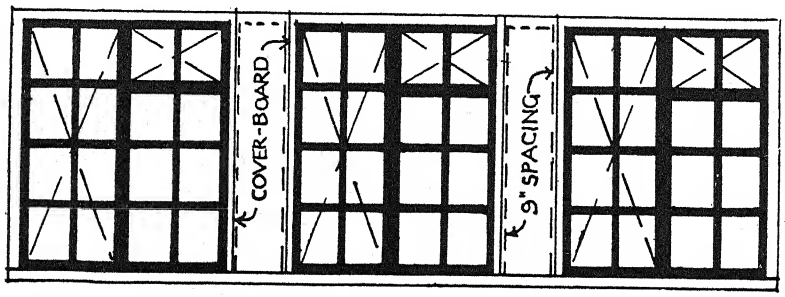


FIG. 137

LIGHTING

If a generating plant is installed it should *always* be in a building outside the house and as remote as possible—otherwise, however slight its noise of running may be, it is almost certain to be unpleasantly apparent during hours of stillness.

If connection is to a public supply (as in most cases it will be) this may be either underground or overhead. The latter is most common in rural areas, and in this case the lead-in should have early consideration, so that a good but not too self-evident point of attachment occurs — the choice should not be left to the company's wireman who comes to do the job, or some unsightly results may occur. A pathetic belief that a big china insulator and a length of cable travelling over a house-front will be unnoticeable is only too common.

In locating the main switch and distribution boards a dry situation and an easy access for inspection and manipulation should be chosen, and it is *not* advisable to place the gas-meter in the same apartment—the consequence of a slight gas leakage and a flash or spark as from a blown fuse can be unpleasant.

In wiring internally, only two systems are worthy of adoption — the screwed conduit and the metal sheathed distributor. The former is self-sufficient; if the latter is used, wherever it is buried in wall-plastering additional protection should be given by metal tubing, since it is all too easy for joiners fixing skirtings and the like to drive nails with uncanny certainty so as to perforate the insulation and produce "shorts" which are only discoverable on test (generally on the eve of occupation), and only rectifiable by digging out the offending portions with detrimental effect to plastering.

In the lighting of rooms two systems (supplemental one to another) were until recently current; these may be named broadly "general" and "local," but now a third must be added, somewhat confusingly called "architectural," in which the placing of points has more regard for decorative effect than for sheer lighting efficiency. As either general or architectural lighting (unless higher intensity than usual is aimed at) is more fitting to repose, conversation and what may be called passive occupations than to any activity such as reading, sewing or drawing, each should be supplemented by a sufficiency of plug points which will enable a local light to be so placed that it may be directed on the object of attention. The situation of plug points is a matter on which disagreement only too often occurs, and it seems quite unusual for a house to be fitted without a few such being altered or added. As to level, the skirting seems the most generally favoured place, but in plan-distribution there is less unanimity—as a general guide situations beneath window-openings are less liable to clash with the placing of heavy furniture, and so more likely to remain readily accessible than intermediate places.

Ceiling points are often inadequately fixed—though not a popular proceeding it is a wise one to hang heavily on the base of any ceiling fitting designed to support a weighty bowl or globe. In one such case recently so tested it was disclosed that only one of the three screws which supposedly held the base entered a firm substance, and frequently the support intended is equally illusory.

PLANNING OF LIGHT POINTS

Nothing but scorn is deserved by the designer whose idea of room lights is a single central ceiling point, which is only really applicable to apartments which are "used" rather than occupied.

The Living Room or Lounge requires dual lighting embodying a

general illumination supplemented or substituted by a sufficiency of local lights to enable each potential user to carry on such occupations as writing, reading or sewing with the utmost comfort in every likely place. This usually involves a minimum of four plug points in addition to the general illumination by ceiling, wall or " architectural " lighting.

The Dining Room is most comfortably lit by a screened low-down light source over the table; fashion may dictate other schemes, but this system generally returns to use. In the small house some form of rise-and-fall pendant is most convenient in this position, and the type of counterweight fitting in which the weight consumes the flex as it is raised or lowered is the neatest in design. Apart from detailed design, the aim of the fitting should be distribution of light over the table without glare in the eyes of seated diners. Though rudimentary, these points are not always observed.

The Kitchen needs light at three definite points—on the cooker, over the sink and above the table or workbench. Often it is possible to satisfy these needs with two actual light-points, but rarely with one. The sink light should not be so far back that any user when bending interposes a shadow. The point above the table may conveniently be fitted with that type of lampholder which contains a side outlet enabling it to be used also for plugging-in minor appliances such as toasters or irons. The flex connection to such accessories is more convenient when brought from above in this way than when it originates at or below table level.

Bedroom lighting is usually needed at two points—adjacent to the bed-head and to the dressing-mirror. In a large room general illumination may also be desirable but in most cases the dressing light will serve this purpose. Rules are nearly impossible, owing to the variety of personal idiosyncrasy met with, but a reasonably safe practice is to arrange a plug-point close to the selected position of the bed-head and a ceiling point centrally with the chief window and 2 feet out from the wall. If a fitted wash basin is supplied a bracket point above, as shown in Fig. 129, should be added. The one-time invariable provision for reading in bed by a pendant and pear-switch above would be better abandoned—such a fitting casts light on the eyes of the user and any one of the various forms of special bed-head lights is vastly more comfortable in use.

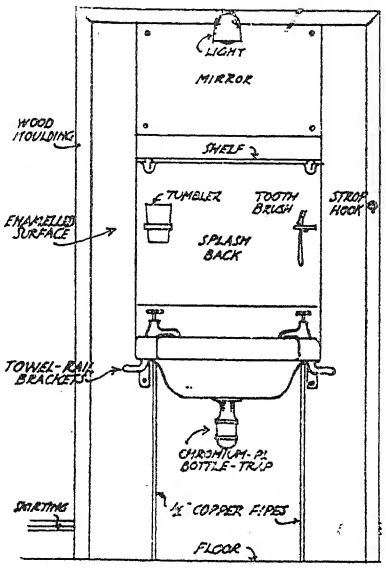


FIG. 129

Bathroom lighting should be by an enclosed and watertight ceiling fitting with a possible supplementary shaving light. Plug points of any sort may be a source of danger to users and are best omitted. Fatalities from contact with " live " portable fittings are not unknown, and risk should be avoided. If an electric heater is desired, either a built-in wall panel or a radiant ceiling fitting correctly installed can be safely employed. Incidentally, a

combined heating and lighting pendant fitting is sometimes a convenience in such positions as *doctors' waiting rooms,* where wall-space for seating is valuable and any floor-level heater would be appropriated by the few to the exclusion of others. Distribution from a ceiling-heater is general and impartial.

Switches. Silence of operation is an important point in choice of switches and attention should be directed to it. Minimum projection is also of importance; semi-recessed types which have their bases buried in the fixing-blocks are the most protuberant that should be employed, and the flush type recessed in wall boxes is always preferable, though more costly and troublesome to provide for. In cases where extreme economy is essential, ceiling switches operated by the pull of a cord effect considerable savings in wiring and conduit.

HEATING PROVISIONS

The electric heater—tubular or radiant—claims 100 per cent. efficiency but it must not be overlooked that this claim is dependent on exclusion of air-change which is inseparable from "fires," whether solid or gaseous fuel is used. After personal experiment in the use of every principal type of electric heater, the writer is of opinion that unless combined with some efficient ventilating scheme (reducing gross efficiency but increasing comfort), these are better restricted to positions where occasional rather than continuous use is in contemplation—in a dining room, for instance, where a constant mild background of warmth is provided by radiators, a built-in electric "fire" may give additional heat and the appearance of cheerfulness when the room is actually in use. The portable electric heater—either the economical "bowl," or the more ambitious type with tubular elements, or the recent distributive forms which embody fan-propulsion of warmed air—is most useful for "between-season" warming, and no room with current available should be without at least one 15-amp. plug point available for connection.

Tubular radiators of the non-glowing type and electrically heated towel rails are both of service (even in conjunction with central heating) in situations where difficulties of access for circulating pipes render hot-water radiators or towel rails almost impossible, but both are apt to consume unexpectedly high amounts of current which in the average house restricts their use to cases of real difficulty or localities where specially low charges are in vogue.

ELECTRICAL HOT WATER APPARATUS

The possible addition of immersion or "tank-belt" heaters, in conjunction with insulation, to ordinary cylinders used in hot-circulating systems, has already been mentioned under "Hot Water Fitter." Direct provision for electrical water heating may take the form of "storage heaters," such as the "Sadia," which embody submerged heating elements with thermostatic control gradually heating a stored bulk of water sufficient for calculated immediate needs to a pre-arranged temperature; or it may be a high wattage "instantaneous" type, heating water as it flows. The latter type is unpopular with many supply authorities, and if permitted "step-up" switching is often stipulated. The storage type, on the contrary, is favoured as a consumer of current during periods of low demand. Electrical water-heating appliances all share in one advantage possessed by no other form—they need no flue for combustion products and connections are more inconspicuous than in other cases. Hence they can be placed in situations which

are difficult or impossible for solid or gaseous heaters.

ELECTRIC COOKERS

It is possible that electricity charges may be generally reduced so as to make the cost of full-scale cooking by electricity comparable with other means. As things stand, the drawback to most electric cookers is the time-lag after switching on with the corresponding residual effect after switching off. Familiarity can reduce the serious results of this characteristic, but judgment is still needed at the latter end of any operation, since after switching off cooling at once begins, and if cooking is less far advanced than has been believed so that the residual heat fails to complete the operation, the result may be a most unwelcome *contretemps*. The precise and inflexible quality of the heat generated in an electrically-heated oven may at first glance be thought an advantage, but in some circumstances it proves otherwise, since its effect is cumulative as long as current remains full on. Furthermore, cleanliness in operation, which is commonly held out as the supreme virtue of electric cooking, proves in practice less complete than might be hoped, since it is from the spluttering of fat caused by *any* form of high-temperature that most of the mess arises.

The most hopeful form for further development of electric cooking may prove to be the heat-storage type—an electric equivalent of the " Aga." By this method of application a relatively small continuous flow of current serves to maintain at a steady temperature a heavy block of metal with the same result as in solid fuel types, but with added facility for " boosting," since by changing over the current to alternative elements giving direct heating by normal means, rapid increase in heat as desired could be obtained, and checked when requisite. Great elasticity seems possible by this system together with important reduction in peak demand for current, since the aggregate wattage of such a cooker is much less than with normal types. Even so, special rates for current must be granted to make cooking economically possible.

OTHER ACCESSORIES

The electric vacuum cleaner and the " mains " radio are now almost standard practice and provision of plug points must not be forgotten. Electric clocks, and bell services run off main installations are also well worth providing for, the latter in particular giving much better results than battery operation, and having become economical since the production of transformers at about 30s.

Fortunately, the crazy poles which attended the early days of radio are no longer necessary, removing one cause of disfigurement due to modern invention. Provision for an aerial either within the roof space or in some other inconspicuous position might well form part of any specification. The telephone should also not be forgotten—a useful manual for architects and builders is issued by the P.M.G. and should be consulted early. Similar care as to prominence of insulator and bracket, as already mentioned in connection with overhead lighting connection, is advisable.

It is a curious reflection how much of the disfigurement of architecture and scenery is due to one or other application of electricity—telegraph, telephone, lighting, wireless, rail, tram and bus overhead conductors! The commonly execrated " pylons " are perhaps the *least* objectionable of such landscape features.

SPECIAL FITTINGS

The vast selection of lighting fittings now available to choice, as com-

pared with the limited (and usually hideous) range which a few years ago faced the selector who desired to go beyond the "plain pendant and shade" dangling at the end of a length of flex, is evidence of the live state of the electrical industry. True, most of the wide range referred to will be found inapplicable to everyday house design, but there are notable exceptions. Most of us have fallen for the neat simplicity of the various globular, cylindrical, and other untortured geometrical shapes in which a few firms specialise; and the need for built-in lighting units which it has been customary to meet rather clumsily by "pockets" constructed in ceilings and walls (in which batten-holders and bulbs would be fitted and covered by surface frames, glazed and made to open for access) can now be met by expertly designed recessed fittings embodying high-intensity prismatic reflectors scientifically made to suit any desired light distribution for either vertical or horizontal lamp placing.

While the larger types generally go beyond domestic needs, some of the smaller, such as illustrated in Fig. 139, are eminently well suited for the lighting of entrance porches, halls and loggias. The provision of lighting points for the latter "semi-external" position is too often forgotten, thereby seriously diminishing its usefulness of summer nights when it might be most welcome. It may be mentioned as an advantage that the installation of a flush ceiling-light in such positions tends to reduce attractiveness to moths and other flying insects, which can constitute themselves a serious nuisance after dark.

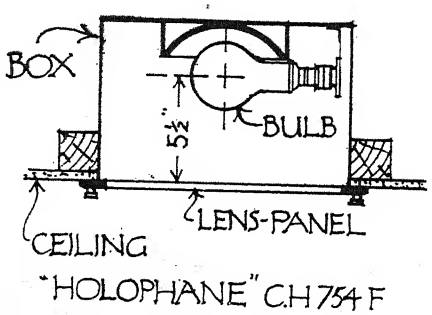


FIG. 139

GASFITTER

Materials and Generally. — The piping of a house for gas may be carried out either in screwed barrel or in "compo" piping; the latter having some advantage in ease of installation, heavily offset by liability for buried pipes to be perforated by nails. The relatively slight expenditure entailed in piping a house for a complete installation, as compared with one or two selected points, makes it desirable that this should always be done during building; points not required can always be blanked off. In comparing the respective virtues of gas and electricity the fact that incandescent gaslight is softer and more pleasant must be weighed against the lesser facility with which it can be applied to such items as portable reading lamps and ceiling points in 8-ft. storeys, and also the blacking of ceilings as a result of its use. Having for many years enjoyed the advantage of a dual system (and having in these circumstances fallen back on gaslight upon the not infrequent occasions when electricity temporarily failed), the above is the writer's considered opinion.

In localities where electric current is not available, gas for lighting and heating may be—either as a public supply, or by the use of "bottled" Calor gas which can be employed in precisely similar fashion. Other alternatives are petrol gas or acetylene, in either of which cases greater care should be taken as to the pipe-jointing, as installations which are effectively gas-tight against coal gas may not prove so to these more volatile gases. Specially designed apparatus is requisite for the use of these alternatives, and, in the case of acetylene, lighting is the only form of employment recommended. In a small isolated cottage it is sometimes

convenient (and ridiculously cheap) to install acetylene light to five or six points, conducting the main supply pipe to an external position where a length of rubber tubing connects to a simple bucket form of generator in the open air. If undue gas pressure develops the rubber tube blows off, and any risk of dangerous explosion from a leaky generator is obviated by its unconfined position.

Petrol or air gas is generated by most ingenious and fascinating plants which experience has shown to be effective and remarkably trouble-free in use. Motive power can be either mechanical or simple gravity similar to the old-fashioned clock weights. For the latter scheme a direct and unobstructed vertical drop, with firm fixing for the bracket supporting the weight-pulley, is requisite, and a sturdy chimney-stack upon an external wall makes the best provision. In emergency a stout tree trunk can be made to serve.

Installation of Piping.—It is one of the minor drawbacks of gas that at certain times condensed moisture collects in the piping. Recognition of this fact can do much to minimise the inconvenience which may otherwise result. It is the general custom to lay piping almost solely between the first-floor joists, with drops to ground-floor points and rises to upper ones. If care is taken to see that no dips occur in the floor distributor system, which is roughly horizontal, and the vertical riser from the meter is fitted with a tee connection and drop-pipe with a plug as in Fig. 140, a good deal of moisture can drain back here without causing trouble, and the plug becomes a convenient point of attachment of the gas-fitter's exhaust pump if clearance becomes necessary.

If a gas cooker is installed, it is a further advantage for the supply pipe to this point to be separately run from the main riser, and it should be of ample size.

Supplies to gas fires of modern types need not rise obtrusively from floors, as was usual in earlier times, but can be decently hidden within the recess provided for the fire, though the actual connection under these circumstances provides an uncomfortable job for the fitter.

HEATING BY GAS

The gas-fired hot-water boiler will be discussed in a later section. Present attention is directed to radiant fires, and hot-air or convection heaters.

Radiant Gas Grates.—Since the designers of gas fires realised that their ideal need not be the simulation of a coal grate, the use of this handy form of room-heating has been greatly extended, and the visual form of the appliances immeasurably improved. For people who do not relish "whole-hogging" central heating, it is probable that one open coal fire in living-room or lounge will remain popular for many years yet (though even this may be a "Metro" coke fire with gas lighter), but for all other rooms, and particularly for a dining-room having supplementary hot-water heating, the gas fire offers great advantages in ready availability, rapid response, cleanliness, and some ventilating effect.

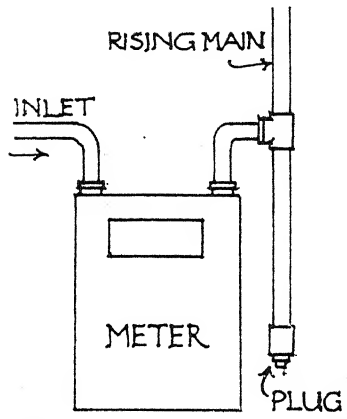


FIG. 140

When fitting fires of the panel type, it is advisable that they should be placed at least 9in. above floor level, unless a hearth is provided. No trimming or hearth is, of course, necessary, but in its absence a carpet or rug may easily become scorched if the radiants extend to near floor level. It is also worth mention that clothing may easily suffer a similar fate—particularly the trouser-backs of persons taking the favoured male attitude! The liability of gas fires to produce water vapour which may condense on cold flue surfaces is a factor against which it is desirable to provide.[29] Covered flue tops, as described under "Bricklayer," are a useful specific, and the grouping of flues with open-fire or boiler flues also helps. An open top 9-in.-diameter flue is not necessary for the ordinary gas fire. In some cases where precautions have been neglected, condensed moisture has been sufficient to cause efflorescence or blotches on wall surfaces adjacent to flues. If for any cause a portion of the flue of any gas appliance should have to be in piping, asbestos-cement is greatly to be preferred to metal, owing to its freedom from corrosion.

Gas Hot-air Heaters.—The type of convection heater which warms and distributes fresh air admitted from outside can often be usefully employed to obviate chill throughout a hall, stairs and landings. Suitably installed, these appliances can also serve as screened fresh-air inlets in hot weather when the gas is not ignited.

Gas Water Heaters.—As regards the gasfitter, these appliances need only a gas connection of suitable size. Cautionary advice as to planning for easy water connection and flue outlet for combustion products has been given already. The location of a multi-point heater needs careful choice; the bathroom is usually the least suitable position if another is available.

Gas Cookers.—Wherever gas is available, the modern gas cooker may be regarded as a standard provision, and so wide a range is available that practically any requirements can be met, ranging from a simple gas-ring to a combination fitting embracing cooking, water heating and room warming. There are also combined fittings such as the "Ideal Cookanheat" which embrace a boiler and oven run by solid fuel with gas auxiliary heating for the oven and hotplate. One type of appliance alone seems lacking, and this is one which has always seemed to the writer to be desirable—an expertly designed gas cooker with all modern refinements, compactly designed, in conjunction with an equally expertly designed solid-fuel-burning boiler. So often gas cooker and boiler have to be installed side by side that actual relationship might seem inevitable.

In the installation of gas cookers, two external problems arise. (1) Treatment of adjacent wall surface; and (2) removal of fumes. Glazed tiling carried to at least 6 ft. high seems the best resource to meet the first problem, and an independent flue next the boiler flue, to which some form of hood can be connected, is desirable to meet the second. It should not be overlooked, however, that such a flue may act in reverse when the cooker is not in use, resulting in a flow of cold air; so that a check damper is desirable. A metal hood may also condense steam and vapour, and result in dripping of moisture. The asbestos-cement firms supply one-piece hoods less subject to this effect.

HOT-WATER SUPPLY

Generally.—The installation of domestic hot-water supply in the average-sized house, when no central heat-

29 Similar and worse effects from coke-fired boilers have been noted by BRS, *e.g.*, 3rd series, Nos. 172, 200, 225.

ing is intended, may well form part of the ordinary task of the plumber and water-fitter. If reasonably proficient and possessed of common sense and some regard for other considerations than his own immediate aim, there should be no reason against successful results. Truth, however, compels the conclusion that in a large proportion of cases above the minimum requirements, results less than completely satisfactory are all too common, and on the score of dependability, the employment of specialists is fully justified whenever needs grow at all extensive or complicated—particularly in country districts, where local practice still tends to crudity.

Such elementary points as restriction of changes in direction of circulating pipes (whether by bends or elbows) to the absolute minimum,[30] avoidance of sags or dips and maintenance of a definite rise or fall in pipes approximately horizontal, provision for the inevitable expansion and contraction of pipes subject to substantial difference in temperature, are apt to be missed, and similar failings are far too commonly met with, in work done by the ordinary fitter. In one installation recently carried out all these faults were committed (and corrected), with resultant annoyance during the process. As regards the question of failure to allow for freedom of movement, the mistake is so common that a few passing remarks in greater detail may be useful.

Allowance for Pipe Movement.—The harmful results of an unyielding fixing for hot pipes may take two forms: (1) pipes passing through plastered surfaces on lath, such as ceilings or partitions, by their movement continually cause spalls of plaster to become detached and fall, with a constant appearance of untidiness. An annular orifice allowing the pipe freedom of movement should always be left, and this is readily done by the use of the divided sleeves and floorplates which makers of hot-water apparatus supply for the purpose at trifling cost. The flanged plate on the surface (which can be had in various finishes, including chromium) makes a neat and permanent finish and effectively closes the aperture around the pipe. (2) More seriously, tension or compression may be put upon the pipe itself, resulting in fracture or the pulling of joints. This is particularly likely to occur in such cases as shown in Fig. 141—an actual instance, when the last-named defect was caused. In this case the main flow-pipe from the boiler (a 1¼-in. copper pipe) was taken immediately through the rear wall, *built round solidly* and turned upward. Copper piping will expand 1½ in. per 100 ft. between 30 deg. F. and 150 deg. F., iron piping 1 in. A leaky joint resulted forthwith, and the surrounding fitting was, by direction, cut away to free the pipe. It is amusing to record that, a complaint being made that the tiling through which the pipe passed had been left, by the man who did this, in a ragged and untidy state, a divided collar and

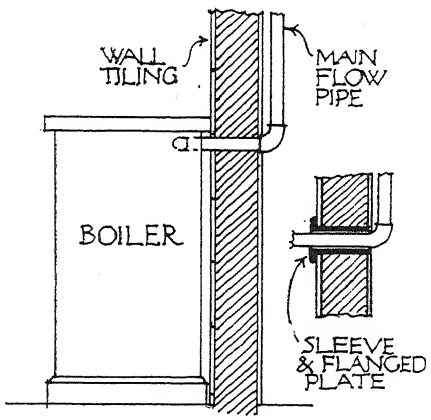


FIG. 141

30 The proportional resistance to flow of water in a 1-in. pipe of changing direction is given as:—sharp elbow, 3; round elbow, 1; bend, 0.75.

cover plate, as above described, was supplied and fixed; but, as well as fixing this, the pipe was *again* filled in solid! This may be taken as an example of the kind of occurrence for which supervisors must be on their guard.

Type of Boiler.—Some general remarks on domestic boiler design were made under "Plumber and Hotwater Fitter." When dealing more specifically with the problem of hot-water supply, the actual choice of a heating method is the first thing to determine. Hot water for domestic use is required more or less constantly all the year round. This differentiates requirements from those of domestic warming, which is neither constant in use nor equal in degree when desirable, but has the counteracting advantage that the same water remains circulating without frequent infusion of cold replacement. The nature of these requirements leads inevitably to the selection of some form of apparatus which will give instant response, but will not waste heating power on raising temperature above the desired level. The appliances which yield this result are many in number, but may be reduced to four in principle. (1) The continuous-burning coke or anthracite boiler, preferably automatically controlled in output by thermostatic check on draught; (2) the gas-fired boiler thermostatically regulated; (3) gas-heated circulators automatically brought into action by the opening of any water tap on a comprehensive distributive system; and (4) local "one-point" water heaters having gas or electric generators, this class being either of the storage or instantaneous type. Neither automatic stokers feeding solid fuel nor oil-firing burners (both admirable in their place, and particularly when by their adoption a reduction of staff is made possible) seem justifiable in the average house with normal scale equipment, though hopper-fed types depending on a combination of combustion and gravity for re-charging may be. This applies both to boilers used for hot-water supply and for heating.

Location of Boiler.—The domestic hot-water boiler, which is constantly in use, comes under a different set of circumstances from the heating boiler, which is operative only when heat is welcome. It is sometimes beneficial to place the latter in a situation where the heat radiated from the boiler itself can be useful, but there are seasons when, although hot water is welcome, the heat given off by its boiler or generator needs suppression. For this reason the hot-water boiler is best placed in some position as remote as possible from places where people must necessarily sit or work. Somewhat similar reasons make it desirable that a gas water-heater shall *not* occupy a position in the bathroom, to which it is often consigned, probably because its predecessor, the geyser, was necessarily fixed there. In the small house the best placing of either presents a difficult problem, particularly when a minimum working kitchen represents the sole possibility. This problem must be faced, and the opinion may be expressed that planning giving a special boiler apartment, which may be a mere lobby to the fuel store, represents the most generally agreeable arrangement.

In such a position two of the minor problems attendant on hot-water installations would also be nearer solution: (1) the safety valve and (2) the drain cock. Safety valves seldom come into operation, but when they do they make a horrid mess, which would be less objectionable in such a lobby. Drain cocks are operated more often, particularly in those districts where annual cleaning of the boiler is desirable. If fitted with hose couplings and placed as suggested, the running-off of the contents of the system should be more easily done, and the actual cleaning of the boiler need cause less domestic disturbance

than arises when this appliance stands in an important room.

Performance and Test.—The preceding notes have related chiefly to matters which the architect must decide or arrange, in consultation with his specialist, if one is employed. For the rest, except for such details as have already been touched upon in the " Plumber and Hotwater Fitter " section, he will do well to leave things to the expert, only stipulating for definite performance and for practical tests to prove compliance. Performance tests need, however, not be confined to such matters as " two baths at 140 deg. temperature within the hour," but may stipulate a maximum fuel consumption and/or a minimum frequency of stoking.

HOT WATER HEATING

Generally.—The point in complication or difficulty at which the introduction of a specialist becomes good policy cannot be precisely defined, since it obviously depends on the degree of proficiency of the architect, as director, and the executant who would normally be in the employment of the builder. When it is decided that a specialist is desirable, he should be consulted before the plans become immutable and any preference which the employer or architect may have as to system and details should be briefly explained to him, after which his draft scheme should be carefully considered so that mutual concessions in arrangement may (if necessary) be easily made. It is the function of the architect, in such matters, to co-ordinate and to prevent any fraction of the work assuming undue proportion to the whole—which is the way of specialists.

Piping System.—Though water is to most people just H_2O, in fact it is seldom as simple a thing as that—even if the H_2O is not plus other important components, recent research seems to indicate that the arrangement of molecules may differ so as to alter behaviour. For the heating engineer, however, there are the two broad distinctions of " hard " and " soft " which must determine the nature of the piping and (to a lesser extent) the design of the system and choice of appliances.

Scale from hard water is relatively of little importance in a heating system as compared with hot water service, since the contents of the boiler, radiators and pipes remain virtually unchanged except for trifling renewals of water evaporated. It is therefore generally safe to rely on iron or steel tubing, and the only cautionary advice needed is that since the initial layer of lime deposit formed in pipes and radiators has a protective influence against rust, care should be taken that the system is run continuously for a few weeks after installation so that this protective film is formed before rust sets in; as it may if the pipes are filled and allowed to stand inactive.

Since deposit is rendered much less severe if the water in a system does not approach boiling point, it may be well to consider in cases where a high degree of hardness is reached either (*a*) softening all water, or (*b*) obtaining domestic hot water in conjunction with heating by the use of a calorifier and dual system. By this means the tendency of the domestic system to accumulate deposit can be much reduced.

In soft water districts scale is not the trouble so much as rust, and in all such areas copper piping is desirable, particularly now that its cost is comparable with alternative methods. Boilers and other iron components can be Bower-Barffed, or in extreme cases made of copper. In default of these precautions, a pulpy sediment of rust is apt to accumulate within the system, even if the severity of the

attack is not sufficient to cause pitting.

In domestic use, the writer's preference is for the one-pipe drop system, which is usually less obtrusive as regards distribution than other alternatives and quite as efficient if well-designed. By this system hot water is conducted directly to the roof-space, where it is distributed by insulated piping to the various drops. The drops themselves are less obstructive to furniture than horizontal piping (which, by the way, cannot be truly horizontal but should have an inclination of at least ½ in. in 10 ft.) and a scheme can usually be devised by which the returns are collected so that a common main below floor rejoins the boiler on a direct down grade, if the stokehold can be slightly sunk, or with a single final " jump " if it must be at general floor level.

The correct sizing of radiators and pipes calls for consideration of many factors which differ in almost every case, but rough general rules ordain that for full heating efficiency as a sole resource, from 20 to 30 square feet of radiator surface to 1,000 cubic feet of space is about the right allowance—auxiliary heating requires, of course, considerably less. It is also commonly assumed that a main flow pipe of 1¼ in. diameter will serve up to 10 radiators and a 1½ in. pipe up to 20, beyond which scale few houses will be equipped.

Pipe-Coating and Other Economy Devices. — Pipe-runs in situations where heat is in demand can, of course, be treated as supplementary radiating surface; in all other positions coating with magnesia non-conducting composition soon pays in fuel economy for its initial cost. Perhaps a word should be said against the fallacious belief (which even some architects share) that asbestos is supreme as a non-conductor. The undoubted virtue of asbestos is its non-inflammability—magnesia compounds are much superior in resisting the passage of heat. In those cases where a plastered coating for pipes is unsuitable, a loose packing of slag wool or glass silk in casing or duct is effective, but no effort should be made to compress either, as if the filaments are crushed resistance to conduction is greatly reduced.

Another point to which close attention should be given is to the air-tightness of the sweeping door which it is usually necessary to provide to the boiler flue. If this is fitted externally (as it is most convenient to do) and furnishes a source for continual leakage of cold air to the chimney, the boiler draught may be seriously impaired, particularly when the endeavour is made to damp down for slow running. Either a double door, the outer hinged and the inner a loose " lid " secured against packing by turnbuckles or similar means: or even some form of temporarily blocking the door-opening by removable brickwork, slate or tile inside the actual door, will avoid complaint of fitful behaviour with otherwise efficient appliances. The sweeping door *must* be airtight.

Boiler and Accessories.—A coke-fired boiler of ample capacity so that it need never be forced to yield proper results remains the cheapest and most trouble-free method of central heating in nearly every case. Where fuel-storage is difficult, or the noises of periodic handling of solid fuel, stoking and clinkering are objected to, or labour must be reduced, there are now admirable types of gas-fired boilers which (though less economical) have the advantages of being compact, clean, smokeless, noiseless and certain in performance, while requiring no labour and practically no maintenance.

Choice of a suitable boiler to fulfil ascertained demands is one of the points upon which unbiassed expert evidence is most valuable. Factors and hot-water fitters alike are prone to advise the use of the particular make in which they habitually deal,

even when another type may offer manifest advantages. A cautionary word is necessary as to the performance of the numerous types of "boiler-stoves" now available for use as sitting-room grates combined with central heating. These are excellent things if it is realised (as many clients do not) that natural laws prevent us getting something for nothing. If the heat-production of the fire is partly devoted to circulating hot water, by that much less it is available for direct warming as a closed or open fire. Recognition of this fact will avert serious disappointments.

CENTRAL HEATING

Heating Chamber.—Heating boilers are so often made to occupy unsuitable positions, and are unsuitably connected to brick flues in domestic use, that a good deal more consideration might profitably be given to this aspect of the general question.

First, as to space and surroundings: in the catalogues of most established makers of heating appliances there can be found useful information, including tables of suitable sizes for heating chambers according to type of boiler, and of suitable dimensions and height of flues to secure optimum results. The Beeston Boiler Co.'s list is particularly informative in this respect, and also in the scientific data which it provides in handy form on such matters as fuel, heat emission, transmission, and so forth.

Usually the minimum floor space which will accommodate the smallest type of heating boiler likely to be employed (neglecting the "boiler-grate" type of appliance which may be fixed in a room) is 4 ft. 6 in. wide by 5 ft. 9 in. deep, arranged somewhat on the lines of Fig. 142. This allows space for making connections and for access to the boiler if requisite, and the relationship of fuel store, entry, and stoking space is convenient.

Precautions against deterioration in disuse.—This is perhaps the place where useful advice (which is generally neglected) as to treatment of heating boilers during summer disuse may be given. A great deal of damage from formation of rust and scale occurs in the fire-passages of boilers, flue pipes, and the like, which could be minimised by care and attention which is not realised as being necessary. When a boiler is disused, moisture caused by atmospheric condensation arises on these surfaces, and this in combination with sulphur and acids from the soot, ashes, and half-burnt fuel frequently left in the boiler, quickly rusts the metal and deteriorates its substance. Briefly, the following measures should be taken when a heating system goes out of use: (1) the apparatus should *not* be emptied of water; (2) the interior of the boiler and flues should be swept and cleaned; (3) the firebars and any clinker or half-burnt fuel should be removed, and no attempt should be made to use the boiler for burning occasional rubbish or paper during the summer months; (4) all doors and dampers should be kept full open to ensure a current of air through boiler and flues to minimise condensation.

Connection to chimney.—Where connection from a boiler to the brick flue is (as usual) by a length of pipe, the joints should be made tight with

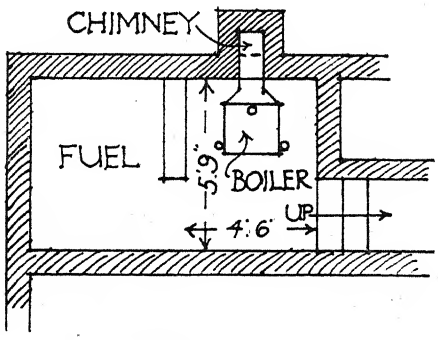


FIG. 142

boiler putty or fire cement. If a sectional boiler is used, the fitter should not be allowed to put cement in the joints between the sections, as this may expand and do damage. The soot door in the brick chimney shaft should be fixed *above* the pipe-connection from the boiler—see Fig. 143—but if the flue continues beneath this level it should not remain as a " pocket," but should be filled up solid with rubble almost to the smoke connection. The soot door should be made airtight by packing or boiler putty. It may seem unnecessary to say that air inlets to the heating chamber in proportion to the needs of combustion are essential; but cases have occurred where the doorway was the only access for air provided, until attention was drawn to this need. In these circumstances, if the door is closed air supply is deficient and the draught is sluggish, or so deficient that fumes and smoke issue into the heating chamber.

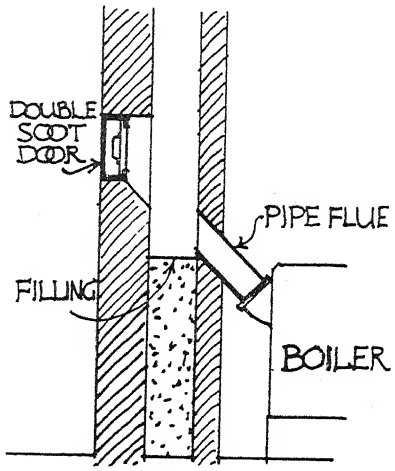


FIG. 143

Radiators.—Types and patterns of radiators are now available in such variety that practically any reasonable need can be met, and material is no longer restricted to cast iron—pressed steel and copper sections are also available. In confined situations, such as corridors or small rooms, great advantage can be gained by the choice of thin patterns, and relative obstruction should always be considered as one of the factors in choice. Height is also a more important factor than is often realised—a low dumpy pattern in certain situations gives much less sense of obstruction than a taller pattern of equivalent heating area. All these factors may not appeal to the heating engineer, who is sometimes thinking of heating efficiency as a sole aim, but should be remembered by the architect.

Provision for deflection of hot air currents (with their attendant dusty stains) should always be made, except where under-window positions can be arranged. It is, of course, a truism to say that situations below windows are the most generally effective for reasons which are well known. Deflection may be attained by the formation of a shelf above the radiator (and the radiator firms produce a stock pattern metal shelf for use where desired); or by such devices as the " Crane " deflector strips which are slid into grooves on the radiator sections, and have a rather pleasing appearance in themselves when fitted. These last are particularly suitable for use with radiators which combine with fresh air inlets.

Fixing Radiators.—Most radiators in domestic use will be installed over wood floors. In such cases patterns without feet and supported by wall brackets are greatly to be preferred. For this there are two reasons: (1) the actual level of the floor surface may be as much as ½ in. lower after joists and boards have fully dried and shrunk; and this may result in strain, or negation of proper " falls "; (2) wall radiators and footless patterns generally do not interfere with carpets or other coverings, and offer no obstructions to sweepers or vacuum cleaners.

The fixing of radiators rigidly but

with some provision for temperature movements is often imperfectly or crudely done, for which there is no excuse, since an adequate variety of clips and holderbats designed to suit all needs is provided by makers. Yet in five cases out of six, radiators in domestic use can be wobbled by hand, having usually no fixing at all other than the pipe connections.

Finally, it is often possible, by skilful layout of circuits, to arrange a fall for the main return above floor level (without the final jump to the boiler mentioned in the last instalment) by mounting ground floor radiators higher above floor level than is usually the case—either on wall brackets, tall feet, or a specially made wooden base.

REFRIGERATION

The installation of a " fridge " as part of the normal equipment of a house is increasingly common, and probably has only to become still commoner to secure some reduction in the present rather high cost (in proportion say to a motor-car) of these useful appliances. Architects naturally have a preference for built-in types, for their neatness of effect, which is in accord with the general tendency of flush fitted kitchen design.

The domestic type of refrigerator may be on the compression system, which involves moving parts (a motor and compressor), and is always electrically run; or on the absorption system, deriving cold from heat, which may be generated either by electric elements or a small consumption of gas. All types embody a thermostatic governor, upon which operation depends, and although all are nominally silent, the types having no moving parts are most certain in this respect. All alike are quite simple to fix, and require merely an electric or gas connection, but provision should be made in the built-in gas types for a slight circulation of air to and from the burner. Makers of up-to-date kitchen cabinets embodying space for standard refrigerators recognise this need by the provision of grids. The running cost of a domestic refrigerator of between four and five cubic feet capacity is approximately 2d. per day. It may be worth mention that gas-operated types have the one incontestable advantage that they are not liable to cause wireless interference.

VACUUM CLEANING

The day may be still remote when a piped vacuum system with fixed suction plant forms part of the equipment of the ordinary house, but, practically, such an installation would be as much in advance of the present portable cleaner as modern sanitation is in relation to a cesspool or privy. The essentials of such a system are relatively simple, consisting (apart from portable attachments or tools) of a collecting pipe line with inlets, and a central exhauster and dust-separator. It does not seem impossible to conceive a rotary vane pump with ancillary fittings combined in a compact appliance at moderate cost which could be available to meet the small needs of the average house. The considerable share which dust takes in the inception of diseases is becoming more generally realised. Piping must be smooth inside, a condition met by the use of cold drawn hard steel tubing, and should bend by long sweeps.

SANITARY FITTINGS

Points governing the selection and installation of the normal sanitary fittings provided in the ordinary house —bath, lavatories, sink and w.c.s— have been touched upon under " Plumber." A few miscellaneous matters relevant to available alternatives and supplementary equipment remain to be mentioned.

Baths.—As substitute for the customary 5 ft. 6 in. or 6 ft. tub bath it might often be worth while to consider the installation (in the same space) of a 4 ft. stepped " minimum " bath and a stand-up shower, fed, not

by an overhead spreader, but by a shoulder-height ring pipe with converging fine jets controlled by a blender (see Fig. 144). Though the stepped bath is professedly intended for use where inadequate space for larger types is available, it has independent advantages for people subject to rheumatic troubles (particularly lumbago), and when used in conjunction with the regulated sluice possible with the adjacent shower, is appreciated by all such sufferers—who are numerous. Spray baths of the type described possess the further advantage that a succession of baths at any temperature, or graduated from hot to cold, can be taken by a family in record time and with minimum water consumption. There is no risk of complaint that the first bather took all the hot water! The "bath, breakfast, and 9 o'clock train" dilemma so common in the suburbs can be greatly eased by this provision.

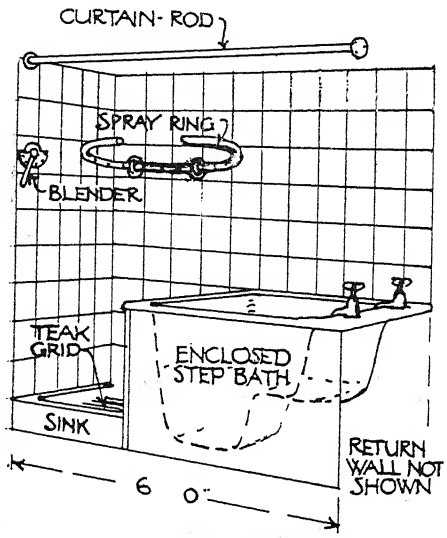


FIG. 144

Bidets.—The use of these appliances may grow. It should be noted that they should be connected to waste-pipes and not to a soil-pipe.

Lavatories.—When choosing wash-basins, there are three points beyond the general ones mentioned previously which should be observed: (1) An internal shape which does not encourage "slopping over" should be sought. This may take the form of an incurved contour near the top, or of a secondary dishing beyond what would normally be the rim (see Fig. 145). With some patterns of basin it is virtually impossible to have a good wash without spilling quantities of water on the floor. (2) The soap-trays should support the soap on ridges out of contact with the surface, and should have adequate provision for drainage—soap reposing in a puddle is unpleasant to handle, and wastes. (3) The overflow arrangement should be cleansible, but *not* so placed that trinkets removed during washing become liable to be swept down.

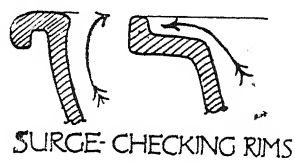


FIG. 145

W.c. apparatus.—In selecting the ordinary pedestal, a form having a straight back and large water area at the standing level will help greatly in preserving the interior from being constantly fouled. The flushing rim should contain provision for "after flush." Corbel types are less common than they deserve to be—they possess advantages (compared with types resting on wood floors) similar to those referred to when describing wall radiators.

The possibilities of plastics for w.c. seats should not be neglected; they are available at reasonable cost in black moulded material, which is both sanitary in use and of good appearance.

Where an overhead flushing tank is retained, the benefit of a rubber pull-handle should be recognised. The one-time invariable damage to adjacent wall surface can thus be avoided.

WATER TREATMENT APPLIANCES

A water supply of potable quality is the one *essential* service without which no intending builder can properly proceed. In the vast majority of cases where new houses are projected the supply will be from a public supply-main under the control of a local authority or a water company. In such cases it is only necessary to be sure that pressure is sufficient to deliver water freely to the highest level requisite, and to comply with the regulations of the supply authority in order to ensure adequate supply. The water may perhaps be of an undesirable degree of hardness so that treatment is advisable, of which more later.

In situations where it is necessary for a building owner to procure and arrange his own water supply the matter is of course less simple, and large sums of money may easily be spent—and even wasted—in the attempt to obtain a suitable source and to make it available for use.

Water-source. — The independent source may be, broadly, (1) a spring at a higher level, needing only to be impounded and led by gravity to storage; (2) a stream from which water can be raised by ram or pump to the required level; or (3) a dug or bored well—usually needing the installation of a pump, but in some favoured areas possible as a true artesian well in which water will rise and overflow without further aid.

In districts where class (1) is the common resource, local firms are familiar with necessary provisions, and the expert (apart from the analyst who should be called in at the start) is superfluous. Where class (2) provision is the best procedure, the problem is more complex, and there is undoubted benefit in making this section a specialist job, subject to guarantee of success. The best known and most reliable firm of specialists will prepare and submit schemes to meet any reasonable requirements, and carry them out to satisfaction. Where the hydraulic ram is adopted, it may be that the flow of usable water is insufficient to provide a supply with the marginal waste involved in obtaining the requisite power, but in this case a different type of ram may solve the problem by utilising a flow of unfit water sufficient to actuate the ram, which thereby raises the separate (lesser) flow of pure water as desired.

In class (3) cases, the information available at the Geological Museum, South Kensington, as to water-bearing strata and existing wells may be useful as a preliminary guide, and specialist firms of well-sinkers who have done work in the district also generally have useful data. It pays to employ experts on such work.

When a flow of water is secured and tests have shown its potable quality, the choice of pumping method also requires expert judgment. For example, if the flow is small but steady, it would be foolish to instal a pumping set so powerful as to drain the well and suck air before storage was filled. In such a case a very diminutive pump and motor working over a longer period is to be preferred, and with modern resources such as automatic switch gear controlled by floats in the storage cistern there is nothing against such a scheme.

There is also a form of electrical pump in which the actual motor, as well as the pump, works submerged at the bottom of the well-tube, dispensing with long actuating rods, which are a potential source of trouble in deep wells. Incidentally, where pump-rods are installed, provision should be made in the well-house for the possibility that some day they may have to be withdrawn; a trap or skylight vertically above the well-shaft allows this to be done.

Filters.—Filtration of water requiring such treatment may take place at the source, at a point adjacent to storage, or by a pressure filter at-

tached to the draw-off. In either case it should be remembered that a neglected filter may be a source of danger rather than a benefit. The first two classes of filter are most commonly "sand filters," in which water entering the impounding tank or storage cistern is made to pass through layers of clean grit of varying grades by means of a series of baffles which ensure both upward and downward movement. In the design of such appliances it is necessary that inflow of water shall not disturb the filtering material, and that rapid outflow shall not carry with it any of the finer grains. This may be secured by entry of water first to a receiving chamber, from whence it passes next to coarse material, and by the overlying of the finer material by a coarse top layer beneath the water surface. See Fig. 146. Filters for use in conjunction with underground storage (which is preferable for bulk supplies) are most usually of concrete or rendered brickwork, but when raised storage is adopted may be of any material ordinarily used for cisterns. Most specialist firms have their own stock patterns.

Tap filters are of another class and usually involve passage of the flowing water under head pressure through porous pottery sleeves (kaolin) or "candles," which can be removed for cleaning or renewal.

Softeners.—The "base-exchange" softener is now a well-established a cessory which may be used with co fidence on main supplies having a undesirable degree of hardness. would be invidious to indicate a pr ference for one make as compare with others, where so wide a choic exists, but the opinion may be e pressed (based on experience working) that types which introduc the salt-flush from a container c brine solution are handier in use tha those which require dry salt to b placed in the softener by removal o the cover. The quantity of salt use may be considerable, and storage mus be provided. A further opinion o the writer is that patterns which em body all necessary valves for bypass ing, salt-flushing, and normal actio are to be preferred to others whic require these apart from the applianc itself—they are neater in appearance easier to connect, and less confusin in use. Some form of indicator whic could be relied upon to inform user when regeneration is needed als seems a desirable accessory, as it i impossible to resist the conclusion tha many softeners in use fail in thei function for an appreciable part o their time owing, not to any defec in their design, but to impropei handling in the absence of this know ledge. A simple water-meter, less precise than the rather expensive type used to govern payment, seems no impossibility, and would be a boon

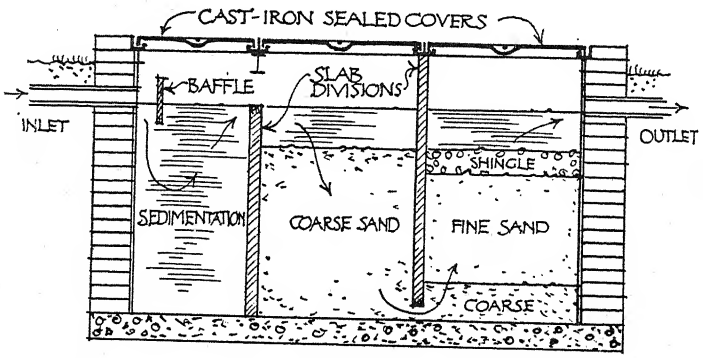


FIG. 146

as an accessory to a domestic softener dealing with entire supply.

GRATES AND MANTELS

The remarkable transference of the source of supply of this section of ordinary house equipment from the ironfounder to the clayworker is one of the pronounced features among the changes which have occurred between the practice of 30-40 years ago and that of the present day. In that past age the customary procedure was to fix cast-iron " mantel-register " grates in minor bedrooms and rooms of lesser importance generally, and though most of these were crude and vulgar in form and of poor efficiency, better types were available for those who cared, such able designers as C. F. A. Voysey and Arnold Mitchell having contributed ranges of types to several firms.

Less stable practice prevailed in important rooms, but generally the custom was to build in an " interior grate " comprising a fireclay " Teale " back of type differing little from current practice, with a metal rim and canopy, loose firegrate and " fret," and a wood chimney-piece of greater or less elaboration in design, the intervening space between " interior " and " mantel " being made out by slabs either of marble or glazed tiles facing concrete slabs. When well designed and appropriately selected such fittings were (and are) practically efficient and of admirable appearance. The good qualities of the " Teale " type back are still recognised, the metal rim protected the surround from the damaging effects of a fierce fire and covered the joint most subject to expansion and contraction, the canopy checked a tendency to smoke eddies, and the combination of grate and fret permitted some degree of draught-control and consequent combustion. The wood mantel related the fireplace to other furnishings, and the existence of a shelf (serving as a deflector) prevented to a large extent the dusty or smoky stains above the fire-opening which are apt to appear when that feature is absent. The scheme was in fact a good working arrangement, which had (and has) much to commend it.

Some grates had unusual features, valuable in their way: one, the " Bond," embodying a grate sunk level with the hearth, and a bevel-plate (a sort of fireside ha-ha) which intercepted fuel that might be liable to roll from the fire, and abolished the necessity for any sort of fender or kerb, thereby greatly aiding floor-level warmth.

Truth compels the admission that the actual range of tiles most widely available for selection was usually frightful in colour and surface, though, to those who knew of them and were prepared to take the trouble, such varieties as the Dutch and Persian tiles of Van Straaten and the " Medmenham " tiles of Conrad Dressler offered relief. Somewhat later the pleasant and amusing bird and nursery rhyme tiles of Carter Stabler and Adams, in the well-known Poole Pottery colours, gave a fresh resource which to this day continues to expand and to be employed.

Modern Practice.—Though conservative folks may and do still continue the earlier practices just described, it is generally true to say that the customary thing now is to instal everywhere a set-piece made up entirely of marble or slabbed tiles (if the selector trends to the " modern " and " functional ") or of multi-colour bricks or " reconstructed stone," if a sentimentalist. This occurs independently of whether the heating provision is coal, gas or electricity. So far as concerns bedroom grates, this changed practice may be held to be a real advance, and the flat slab surround seems fully appropriate to gas or electric " fires." In living rooms, now frequently the sole situation where the solid fuel fire survives, the " sarcophagus " form which seems currently popular is perhaps less demonstrably satisfactory, and

the stock-pattern Olde Worlde Bricke mantel is even wearisome and not too practical—at least it requires farmhouse supporting detail and furnishings!

Perhaps a few individual preferences may be given without offence:—

Interior Grate.—A 21-in. firelump permits the use of logs—anything less only admits "chumps."

Tiled Surrounds.—Pastel shades and mottled effects which suggest disease can be much overdone. The plain ground with inset pattern or duly conventionalised picture interest is a relief. A small radius rounded edge is preferable to a coarse bull-nose. A visible width of joint of suitable colour can enhance the effect of tiling. Care should be taken at the margin of tiling adjacent to the fire-opening. A high proportion of existing tiled grates (without metal rims) when they have been some time in use show either damaged edges or defective joints, or both.

Slab Surrounds.—Quiet materials such as rubbed Delabole slate, Hopton Wood stone or polished "Perrycot" Portland stone are usually pleasanter in effect and less wearisome than marbles of the "Pork brawn" type. Metal fire-openings are practically essential when stone or marble slabs are employed with a fireclay interior—otherwise damage is almost certain.

Reconstructed Stone Mantels.—These are a form of concrete, and the blocks are subject to irregularities in size—presumably due to shrinkage or slump. It is advisable to set them up in position dry (and not merely to assemble them flat) to check levels and "fit" before erection.

Brick and Tile Fireplaces.—These commonly err by over-design rather than simplicity. The use of standard sized bricks results in too coarse an effect for the ordinary room. Jointing, in colour, width and surface form, is as important as the colour, size and texture of the bricks. A struck joint in cold grey cement is fatal to any example, and black or aggressively light jointing also. For most multi-colours a flush joint between $\frac{1}{4}$ in. and $\frac{1}{2}$ in. in brownish buff gets the most effect from colour. The natural edge of "Celotex" laid in strips between the dry bricks makes a useful test for effect and model for the bricklayer. Quarry tiles, if used, also gain immensely in value from visible joints: *cf.* their use as pillar dados in new L.P.T.B. stations. Remember that smoke-stained brick fireplaces cannot be cleaned.

COOKING APPLIANCES

The built-in kitchen range is probably a thing of the past, having been ousted by the free-standing cooker of the Aga, Esse, Kooksjoie and similar types—all well-bred descendants of the humble "self-setter." Exceptions occur where a sitting-room effect is also desired, and in these cases such types as the Triplex, Servall, and Ure back-to-back ranges meet requirements, and can be treated on generally similar lines to ordinary interior-grates.

DEFECTS LIABLE TO APPEAR DURING THE MAINTENANCE PERIOD

It is (or should be) unnecessary to say that it is better to avoid the possibility of failure by structural precautions, than to seek a cure when defects have shown themselves. It is generally true to say that no cure of a serious defect, which has shown unpleasant consequences, is as satisfactory as avoidance. However, the utmost exercise of knowledge and skill will not exempt architects and builders from an occasional failure, and the knowledge of how best to deal with it is valuable. Even if, by care and good luck, troublesome defects arising in their own work are escaped, they will undoubtedly be called upon to advise upon suitable measures to rectify such annoyances arising in the work of others—both recent and of long standing.

Apart from actual failures in structural strength, which are uncommon and beyond the possibility of general treatment, the troubles most frequently falling to be dealt with may be roughly grouped as those due to the presence of unwanted moisture, which may be either from penetration, absorption or condensation; those due to expansion and contraction, either of cement products or the ordinary shrinkage of timber; those due to fungal or insect attack on wood; surface disintegration, such as the " dusting up " of cement or the lamination of tiles; or failure of one of the services normally provided to function as expected, which may be instanced by chimneys which smoke, hot water which does not circulate, or drains which frequently become choked.

A brief survey of typical defects under these heads, with suggestions as to measures which have proved satisfactory in particular cases, may help to give guidance to those who may be faced with similar problems. Our resources are increasing yearly, and our knowledge of the causes of many troubles of constant occurrence also—largely due to the work of the Building Research Station in investigation and experiment.

Dampness.—The causes of internal dampness are often obscure, and their determination a matter requiring considerable knowledge and skill. For a general survey of likely alternatives, the recent publications of B.R.S. make a most useful starting-point.*

In devising remedies, after the correct cause has been diagnosed, the first aim should of course be to prevent rather than to exclude, though exclusion may in some cases be the only practicable solution.

Penetration of surfaces exposed to the weather—walls, windows, and roofs—is a frequent trouble, encouraged by the penchant shown by people accustomed to the shelter of a town to build in exposed positions in country or coastal districts.

Roofs may leak in consequence of general porosity of covering, from inadequate lap, from capillarity between close-fitting slates assisted by wind, from long slopes in conjunction with too small units, or from unsuitable form of tiles. Apart from cases of general porosity or actual defects, wind is the enemy which usually forces potential leakages into real existence—where wind will go, rain and snow can go with it. The unfailing remedy for occasional minor leakages from any of the above specified causes is a waterproof and draughtproof underlining. No roof should now be laid without such a

* B.R.S. Notes Nos. 253, 256, 257, 261 and 264.

provision, and where serious trouble has arisen from neglect of this precaution, it is on the whole wiser to strip and underline than to tinker with pointing, torching, or similar expedients. Either bituminous felt on a Hessian base, or tough Willesden paper, laid on the rafters *as though it alone were to be the water-excluding roof*, will enable the householder to laugh at any of the defects named; he will have a roof within a roof, and additional insulation against heat or cold as well.

Walls may leak generally or locally from many differing causes set out in the B.R.S. publications named. The attempts so often made to prevent penetration by an external waterproof rendering, carry with them the risk of failure, either from cracking or crazing of the overcoat, or from continued movement of the structure itself—the latter not uncommon in clinker-concrete block structures and lightly built work on shifting foundations. In these circumstances the remedy may intensify rather than cure the trouble. Where it is certain that no movement between structural units is likely, penetration by driven rain can often be so far reduced as to be negligible by the application of two coats of brush-applied slurry of "Supercement," followed by a colour-wash of lime and tallow. If the latter is renewed at intervals as it becomes shabby, this treatment is effective where general porosity, or minor local defects such as capillary joints, are the source of penetration.

"Colourless" damp-proofers can be effective when suitably applied and at the right season, but these also require renewal from time to time as they leach out. In cases of severe exposure, and where minor structural movements are continually recurring, the only reliable resource is an independent covering free to allow such movements without impairing protection. This means a lapped covering of tiles, slates, shingles, or weatherboarding, and a plea may here be made for recognition of the fact that such a covering need not be regarded as necessarily detrimental to the appearance, but may, with a little care, be made positively improving to many a house. Slate-hanging need not necessarily be done with purple Countess slates; it can be carried out in grey slates not over 14 in. x 7 in. in size, and with weatherings at each line of window-heads—and can look really well. Both shingling and weatherboarding are completely effective as an overcoat, and since the commercial introduction of red cedar, can be used with confidence. These place much less extra weight on the walls than either tiles or slates, and are less liable to damage, while they are immune from "chatter." Walls which are severely affected can become quite dry when covered with shingling, and this treatment shares with tile-hanging the virtue that it removes the constant trouble liable to arise from leaky windowheads, which can be covered so as to preclude the need for local treatment. An agreeable practice is to batten horizontally above the ground floor windowheads and use shingles with a soffit-board and weathered finish at the lower level, and to batten vertically below this and fix rebated weatherboards or "siding" to dampcourse level. The siding may (if desired) be painted, which, in conjunction with the natural colour of the shingles above, gives a pleasant effect, avoiding the "hut" suggestion.

A plinth up to splash height painted with such a compound as "Synthaprufe" will prevent not only the absorption of rain at this point, but the soiled appearance which so many colour-washed houses soon take on at their base from this cause. Where a black surface is not objectionable, this compound may also be used elsewhere for rain-exclusion. Internally it has other uses, as will be mentioned later.

Windows may be penetrated between casement and frame, or directly through glazing joints. Leaking metal casements can sometimes have this

tendency greatly reduced by painting heavily; wood casements which are unprovided with anti-capillary grooves can readily be grooved on the edges, but in addition to this in positions of real exposure, some further check may be necessary. A knife-edge metal strip pressed hard against the closed casement so as to bite into the wood, and screwed in that position around the frame, is easy to apply, permits of adjustment as may be required, and is almost unnoticeable when fixed and painted. It should be fixed by paint as well as screws, under which conditions it will exclude draughts very effectively. Provision must of course be made for the fastenings and stays (Fig. 147).

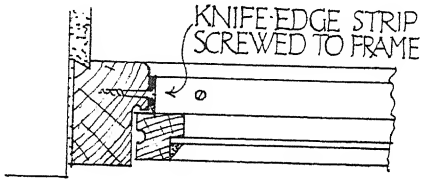


FIG. 147

Water forced through next the putties of glazing, or round lead cames, is hard to trace to its origin, but if this can be found and marked, it can usually be closed by ordinary lead and oil paint applied when leakage is not active. In the case of lead-glazing the edge of the came should be gently prised away from the glass and a drop of paint inserted, after which the lead is pressed back.

Absorption of moisture from the ground, when due to soil in contact with exterior walls in the absence of, or extending above an existant dampcourse has the obvious cure—removal. Cases have been met with, however, where buildings of recent construction, even cavity walled, have been affected by damp interior walling occurring in such manner as to suggest absence or failure of the essential horizontal dampcourse. Sometimes this is traceable to defects in the dampcourse itself, either fracture if of slate, or perforation if of roll bitumen, and this can be assumed as due to damage done while the newly laid dampcourse lay exposed—as it frequently must do when inspection at this level is demanded (and delayed), or when oversite concrete is put in with the walls at this stage of progress. Such defects, if unnoticed at the time, must be discovered and rectified.

But another source of failure which ought never to occur, though in some parts of the country it is not uncommon, is due to the mistaken practice of extending a dampcourse continuously through the base of a wall and starting the cavity therefrom. Instances have been met with in which this weakness was intensi-

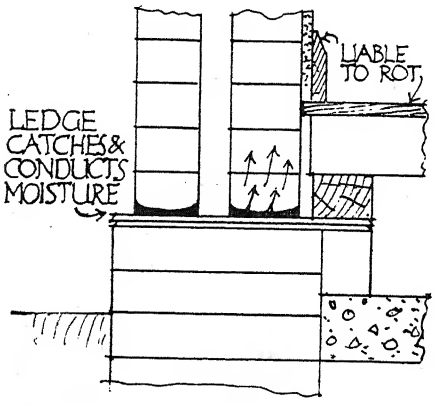


FIG. 148

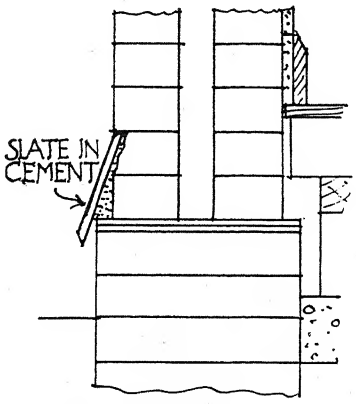


FIG. 149

fied by the formation of an offset at the dampcourse level, in which circumstances the impervious surface (as a moment's thought will show) is liable to do more harm than good. Fig. 148. Cases of this sort present great difficulty. They ought, of course, not to occur; but where they do the offset should be covered by an external slate weathering, either chased into the brickwork above as in Fig. 149, or covered by an extension of external plastering if the work is rendered or roughcast.

In the simpler, but equally indefensible case of the continuous dampcourse, and in those cases where solid walls have proved unresistant to rising damp or penetration, effective exclusion can be attained by an internal resistant coating. If an ineffective or absent dampcourse is the cause, it is usually sufficient to knock off the internal plaster to a height at least a foot greater than there is evidence of rising damp, and either to treat the exposed brickwork with two coats of such a material as "Synthaprufe," or with a waterproof rendering such as "Pudloed" cement, finished in either case with a top-coat of absorbent plaster. It is important with this method of treatment that the external face of the wall should be left free to evaporate absorbed moisture; no attempt should be made to render this waterproof, as this results in the ground moisture being confined so that it rises higher in an endeavour to escape.

Where a complete wall or a whole house is subject to continued penetration, as in many cases where 9 in. external walls of porous brickwork exist, conditions have in many cases been greatly improved by entire replastering internally with waterproofed cement, finished in porous plaster as above described. This treatment has proved beneficial from another aspect also; when dealing with old houses long subjected to periodic penetration of moisture, the plastering and such items as skirtings and architraves have usually deteriorated, so that by removal and renewal, as necessitated by this treatment, dismal shabbiness too is overcome. It will be realised, however, that vacant possession is practically essential to enable this drastic treatment to be applied.

Condensation. — Manifestations of dampness which are obscure as to origin may often be set down to condensation of atmospheric moisture. Under all but the most abnormal conditions, a surface that is slightly absorbent (such as most wallpapers and common distemper) will have sufficient "blotting paper" effect to reduce this annoyance to negligible proportions. A gritty or roughened surface such as "stucco finish" is also effective in this direction, unless painted.

Two causes which tend to aid the formation of condensed moisture should not be overlooked when seeking explanations of such appearances. Everyone has noticed the propensity which closed and unoccupied houses display to develop a damp and musty atmosphere and to show the effects of condensation. With the supersession of the open fire (and its flue) and the concurrent adoption of gas and electric methods of cooking and water heating, which conserve heat to its professed purpose and allow little to escape to perform unavowed functions, many houses tend to approach similar conditions. The existence of a continuous burning coke or anthracite boiler will often mitigate this state, but in "all-gas" or "all-electric" houses, and more particularly bungalows (which lack the ventilating circulation produced by upper and lower rooms), surfaces tend to be colder and air-circulation less brisk than in the presence of the more primitive provisions which have been supplanted. These conditions favour condensation, and the frequency with which houses are deserted in this motor-car age helps in the same direction.

Yet another manifestation, which is actually due to condensation but is

often falsely identified as penetration due to defective chimney-gutters or flashings,† is the blotching which not infrequently appears on plastered chimney breasts near the top floor ceilings. This arises from condensation of flue gases, generally from slow-combustion stoves or boilers, and the burning of moist refuse now advocated by Local Authorities may do something to increase it. The actual condensation probably occurs within the exposed chimney-stack above the roof, which is itself apt to be cold and damp, and thence soaks downward until it appears as stated. The trouble (and the more serious results which may follow continuance) can generally be cured if the stack is taken down and rebuilt with a lining of acid-resisting pipes such as glazed stoneware drain-pipes, socket upwards.

Lamination of Tiles.—The destructive lamination of roofing tiles, occurring often quite early after they had been exposed to the weather, was a constant trouble about 40 years ago, when machine-made tiles first became common and the manufacturers' aim was regularity of shape (which would be lost by strong firing). The internal texture of many such tiles could be seen to resemble the structure of millboard; layers of substance compressed into contact but not fused. In such circumstances the flaking of surfaces from the freezing of interstitial moisture could disintegrate the substance by expansion, reducing a proportion of the roof-covering to a condition of loose laminæ. No remedy for this state of things could be found, other than stripping and relaying, rejecting all unsound tiles. Happily, with improved ideals and greater knowledge of tile-making processes, such behaviour is now most infrequent, but an alternative trouble is sometimes met with, akin to the disintegration of bricks which may be caused by crystallisation of salts. Several such cases have been reported to B.R.S., in which efflorescence appeared on the tiles, and upon examination it was disclosed that the heads of the tiles were shelling away, so that the nibs failed in their purpose and tiles slipped and fell at the slightest vibration. This condition was found to be due to magnesium sulphate (Epsom salts) which must have been present in the tiles, and was dissolved by rain and absorbed towards the tails, whence it evaporated and formed crystals. The warmth produced by the distribution of heating pipes in the roof space is probably a strong inducing factor when the conditions are otherwise present.* The soaking of sample tiles followed by rapid drying so as to disclose the presence of salts in high proportion, seems indicated as a precautionary step. Hot pipes in roof-spaces need an insulative coating as a protective against this tendency, as well as for the conservation of heating capacity.

Smoky Chimneys.—Probably the commonest and most annoying of all defects which afflict the users of otherwise well-designed and soundly built houses is the smoky chimney. Reference to earlier notes under "Bricklayer" may be made for hints on precautionary measures, including the "Smoke-shelf" or baffle. B.R.S. has recently dealt with numerous cases of this kind referring to fire-openings of different character,† and in their latest pronouncement which may be taken as authoritative,‡ they set out very clearly the desirable application of the principles first laid down by Count Rumford adapted to the needs of the current form of grate. Briefly, the requisites for a good chimney draught are (1) a flue opening of slit-form vertically above the fire and of an area approximately equal to the effective area of the chimney. It is stated that 4 in. is the most suitable width for the slit, from which dimension the proportional length can be calculated; e.g., a 9 in. square flue has the *effective* capacity of a 9 in.

† B.R.S. Notes No. 264 (3).

* B.R.S. Notes, second series, No. 128; third series, No. 255.
† B.R.S. Notes, third series, Nos. 220, 229, 259.
‡ B.R.S. Annual Report, 1937.

circle (corners being neglected) or roughly 80 sq. in.: $\frac{80}{4} = 20$ in., the slit inlet being therefore 4 in. x 20 in.; (2) easy inlet to the before-mentioned aperture by sloped or rounded formation, particularly of the head or lintel over the fire-opening, which should not oppose a flat soffit of appreciable breadth to the entry of heated air; (3) the formation of a smoke-shelf, draught-table, or baffle immediately above the throat at the point where the slit

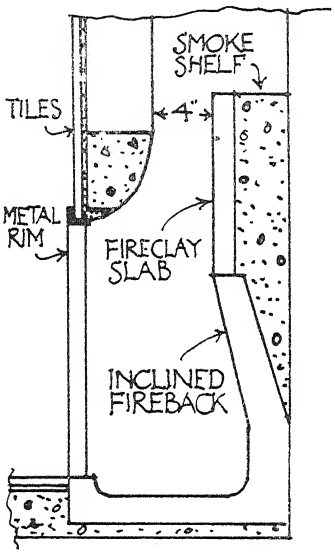


FIG. 151

must necessarily pass into the flue. The occasional drawback to this horizontal surface as a collecting ground for powdery soot has already been mentioned, but the occasional blowing out of small quantities of soot during periods when the fire is not burning is generally accepted as a much less serious trouble than a smoky chimney, which can render a room or a whole house almost uninhabitable. (Fig. 151.)

Cowls and patent pots may sometimes overcome defects whose real seat is elsewhere, but much more frequently the cure is imperfect, and often they accomplish nothing, or even make matters worse. Many common types are also very disfiguring, and once in position (however ineffective) they are likely to remain. Types which are relatively shapely and inoffensive in appearance are the Sankey pot, Fawcett's Edwardian, and the Konkerwind, the latter being in fact almost unnoticeable if incorporated in the design of the chimney and applied to all flues in a stack. In fact, a good deal of the ugliness which is caused by smoke-ejecting pots is due to the casual appearance of odd terminals; where risk of down-draught from external causes exists it is well not to be too hopeful, but to provide in advance against its effects, either by covered chimney tops or special pots. A device quite pleasant in appearance and effective against the annoyance of smoke from an active flue being blown or drawn down an adjacent dormant one, is the fitting of pots differing in height, the central pots in a combined stack being the higher. This was once a common practice and it might well be revived. (Fig. 152.)

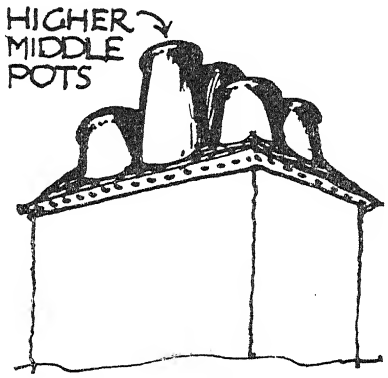


FIG. 152

Defective Action of Drains.—Though drainage difficulties arising as defects after completion are not nowadays frequent, they do occasionally happen. When they arise

they are usually due, not to actual defects in material or workmanship, but to careless or foolish behaviour by workmen or occupants after completion. Perhaps the commonest of all such troubles is that caused by painters emptying the remains of unused distemper into waste-traps, which from this cause are sometimes found filled nearly solid—particularly if a washable distemper has been used. This cause should always be suspected first, if any waste pipe or gulley fails to flow freely; and the cure is obvious. Less common, but by no means unknown, is blockage caused by a scrubbing brush or house-flannel emptied unknowingly down a W.C. trap with washing-water, and lodging in the interceptor. If such a condition arises and remains undetected, drains may become charged with sewage to the point of overflowing from the lowest traps connected, and it then becomes a matter of difficulty to provide for the escape of liquid so that the cause can be discovered and removed. In this state of things the utility of that type of interceptor in which the stopper to the clearing-arm is fitted like a pickle-jar lid, releasable by a partial turn which can be given by a chain provided, becomes apparent, and this type is also useful as a precaution against loss of the stopper, which remains attached and cannot be washed away or mislaid. A considerable number of interceptors exist which fail in their purpose by the absence of this stopper after such removal.

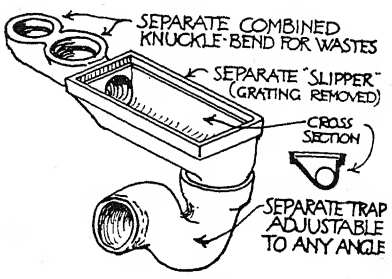


FIG. 36

Another drain failure due to carelessness is traceable to the sink drain trap or grease-interceptor. Houses fitted with orthodox grease-traps containing a removable bucket, not unusually continue for months (or even years) with the bucket uncleared and the drain virtually blocked. The slipper-gulley flushed by a bath-waste connection (as described and shown in Fig. 36) is usually a sufficient provision for the ordinary house and remains trouble-free indefinitely without special attention.

Actual drain defects, such as dips in inclination, insufficient fall, or bad junctions ought not to occur, but complaint occasionally arises from jointing troubles. These may take the form of burst collars on socketted pipes due either to expansion of cement used for jointing or to uneven bearing of pipes bringing a strain on the collars which they are not fitted to withstand.*

Another form of trouble is the extrusion of jointing material into the bore of the pipe so as to form a projecting obstruction which can be the nucleus of a complete or partial stoppage. Usually in either case it may be necessary for the length of drain affected to be taken up and relaid. Extruded jointing can be avoided if the inspection described and shown in Fig. 37 is applied as part of the

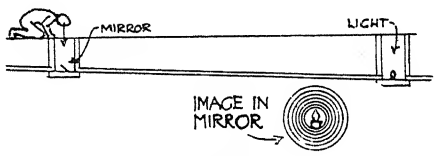


FIG. 37

routine test. Any length of drain which is at a considerable depth or so situated as to involve great disturbance may be worth the attempt to rectify in position, removing obstruction by the use of a scraper and (if a water test discloses leakage) making good defective joints by the ingenious method which specialists can apply, but which is particularly meant for old drains.

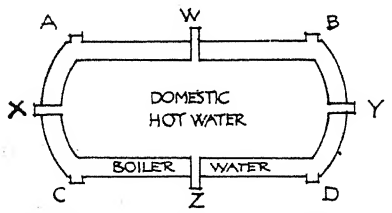
* B.R.S. Notes, 1st Series No. 133.

Hot Water Troubles.—The requirements of hot-water heating and of domestic supply are less similar in essence than is commonly believed. To secure efficient heating, steady circulation of the heated water must be maintained, and since this depends on the trifling difference in weight between fully heated and cooling water is a delicate thing which will not suffer any obstacle without loss of movement. Hot-water supply, on the other hand, though its generation requires brisk circulation between boiler and cylinder, relies on the force of *cold* water replacement to eject the stored bulk of heated water from any tap on the system which may be opened. In both cases it is, of course, assumed that the boiler which is fitted is adequate to its task.

Two defects common to both systems are not infrequently produced by careless fitters: (1) unnecessary bends or elbows, and (2) insufficient provision for the free escape of air from pipe-runs. As to the former, in the event of inefficient working all runs should be closely scrutinised to see that in no case are two bends included where one would do. This condition is sometimes produced by a desire to make easier the actual connection to a particular radiator—it is better that the circulating pipes should be free, at the expense of a single radiator connection, since if they do not function freely even the radiator in question may not get its maximum flow, while the rest of the system unquestionably suffers. As to "air-lock," which is merely a break in the continuity of the loops of water in a pipe, this can be avoided by two minor specifics, and one major provision. Since air is approximately 800 times lighter than water, the latter can only cause imprisoned air to move in an upward direction, and it is for this reason that it is so desirable as to be practically essential that incoming water (otherwise the cold feed pipe) should enter any service system at the lowest possible point. The minor, but very important points are: (*a*) that all pipes should have a gradual rise to definite high points, the *minimum* for "horizontal" runs being 1 in. in 10 ft. It may sometimes be found that in such situations as roof-spaces this rise, if initially provided, has been negatived by later interference owing to insufficient fixing; (*b*) that an open air-pipe is carried from every high point produced by the last-named precaution. It should not be forgotten that it is not only when the system is emptied and refilled that air may be imprisoned; air will arise from decomposition of water heated in the system.

In domestic hot-water supply systems, the commonest defect is failure to draw in ample quantity the hot water which exists in cylinder or tank, either from faulty positioning of the draw-off pipes, or from inadequate size of cold feed, which is the motive-power causing hot water to flow. Often an increase in the diameter of the cold feed pipe will at once overcome trouble from this cause, which tends to increase in frequency with the distribution of extra points (such as fitted bedroom wash-basins) apt to be simultaneously in use.

An unusual failure recently experienced (and quite simply cured) arose from employment on an indirect system of a form of dual cylinder contrary in arrangement to the usual. In this the primary water was in the outer cylinder, the inner one containing the domestic supply, the connections supplied being as shown in Fig. 153. This necessitated use of connection Z for cold feed and W for expansion pipe off which services were



PRIMARY FLOW-A or B : RETURN-C or D
DOMESTIC : X & Y-SECONDARY · Z-COLD FEED

FIG. 153

taken. The immediate consequence was that while the hot water in the ends of the cylinder remained undisturbed, cold water passed straight through to the outlet so that only a dilution of the hot water could be drawn. With this form of cylinder, the usual precautionary fitting of a T spreader could not be introduced, but the " streaming " of the cold feed was prevented by insertion of a copper pipe of smaller diameter than the feed to which it was secured, this " spreader " having its end securely plugged and slots equivalent to its sectional area cut in its sides, from which water would emerge. Fig. 154.

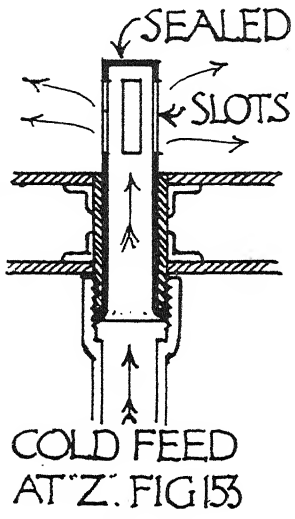


FIG. 154

Water-Hammer and Pipe-Noises.—A number of noises which are liable to emanate from water-fittings or pipes are loosely described as " water-hammer." It should be recognised that metal piping (especially *hard* metal such as iron or copper) is a ready medium for transmission of sound, the origin of which is not easily traced. Pipe noises may originate from any of the following causes—and possibly others:

(1) The too-sudden checking of water in motion—the true water-hammer—such as by the use of quick-acting bib-taps without air-buffers. Obstinate trouble from this cause can be minimised by continuing the supply pipe above the tap as an air-cushion, or by fitting an anti-concussive attachment. (Fig. 155.)

(2) Conveyance of vibration produced by a noisy valve, or the sounds of water from a W.W.P. cistern not fitted with a silencer or containing a flimsy, cheap-quality ball-valve.

(3) Boiling of water in circulating pipes, accompanied by its decomposition and the consequent sounds due to displacement of air. Long *horizontal* pipe-runs in which water and steam are apt to be moving in opposite directions are specially prone to cause noises of conflict. Frequent occurrences of this kind argue an ill-proportioned system, or unintelligent control.

(4) Loud bangs originating from the hot-tank (not experienced with cylinders) when pressure varies on the opening of taps. This is due to a combination of circumstances; (*a*) too thin substance and an undulating surface in the tank walls; (*b*) insufficient size of cold feed causing water to be withdrawn quicker than it can be replaced, so that the level falls. The

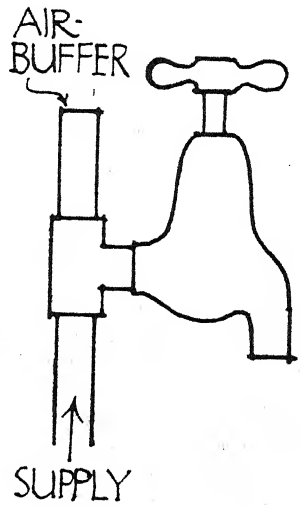


FIG. 155

noise is actually produced by alternation of bulge on the tank sides as pressure varies.

(5) Insufficiently rigid fixing of pipes, particularly light copper pipes, which are capable of producing and transmitting annoying chattering sounds as the effects of expansion and contraction change their form. Allowance for longitudinal movement must, of course, be made, but lateral movement should be restricted, though even so pipes must not be tightly clipped, as this is likely to cause ticking or creaking noises as temperature varies.

(6) Transmission of impact noises external to the piping—usually conveyed from the heating chamber or boiler room. These are unavoidable so far as their occasion is necessary—such as stoking or clinkering.

EXPANSION AND SHRINKAGE TROUBLES

The commonest forms in which troubles occur, consequent on change or fluctuation in dimensions from variation in temperature, moisture content, or other causes, appear as shrinkage or swelling of timber, crazing or cracking of cement or plaster, and (less frequently) bulging of applied surfaces such as tiling (wall or floor), hard plaster, or composition flooring. We are dealing now with defects which have occurred, not with preventive measures; reference to earlier articles will reveal numerous warnings and a few incidental remedies to the commoner and more inevitable defects.

Timber Defects.—The layman finds it hard to appreciate the proved fact that, whatever degree of "seasoning" softwood may have undergone, there are conditions of atmosphere in which further movement (either shrinkage or swelling) may occur. Many should observe additional proof of this from the recent spring drought, when joinery fifteen years in place has been seen to shrink noticeably to the extent of opening cracks in old painting at joints and margins. "Defects" of this kind may be declared irremediable. Central heating, and even the continuous-burning hot-water boiler, have done much to accentuate the early appearance of defects due to shrinkage, and to stabilise effects afterwards; and in some cases it may be worth while to dismount and cramp up such items as doors after initial shrinkage has occurred. Casements are less frequently in need of such treatment, as they are exposed to weather on one face, which restricts shrinkage or compensates it by swelling. The treatment described in Fig. 147 affords a cure to the ill-fitting casement, and one which permits periodic readjustment.

Floors are more difficult. The two most usual defects are open joints from pronounced shrinkage of boards or blocks, and bulging from the swelling of blocks dependent only on adhesion for fixing.

Open joints in grooved-and-tongued flooring are the most troublesome to treat. Short of taking up relaying the floor with closed-up joints (a course which is apt to leave scars from the drawn brads) careful filling of the joints with "plastic wood" is the best that can be advised—but it is only worth while in severe cases. Straight-edge boarding has sometimes been successfully joint-filled by the insertion of plasterer's laths on edge in the open joints, this being a particularly bad case of extreme shrinkage in a bedroom floor above a kitchen where a boiler and cylinder produced conditions approaching those of a drying kiln. When this floor had been traversed by a plane, the effect was quite satisfactory!

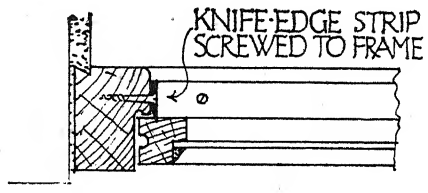


FIG. 147

The swelling of block floors will ordinarily be absorbed by the open margin left for the purpose beneath the skirting. Where, however, it results in portions of the floor rising in blisters, which give a hollow sound when walked on, and may collapse beneath the load of a table-leg or similar object, something must be done about it. A localised blister of this sort is usually due to some interruption of the waterproof adhesive in which the blocks are laid, in conjunction with dampness in the concrete base. When relaying it may be well to supplement such precautions as waterproof screeding and Synthaprufe bedding by arranging screw fixing for a proportion of the blocks (about one to each 4 ft. super) to fixing-bricks or creosoted blocks bedded in the concrete. Surface defects in exposed woodwork can often be remedied by a sort of "dental filling," using plastic wood; knots, checks and bruises treated skilfully in this way appear to last well. Shakes and cracks in unwrought oak timbers have been successfully disguised by packing with pulped newspaper, but this, perhaps, approaches perilously near the art of the faker!

Defects in Cement Rendering and Roughcast. — The trend of modern architecture has thrown into great prominence the unfortunate propensity which cement-rendered surfaces have shown to crack or craze, and to weather to an uneven degree of shabbiness. These troubles have engaged the recent attention of B.R.S., and in the 1937 Report of the Board valuable suggestions are made towards their avoidance—briefly, it is advocated that undercoats as well as surface should be thrown on rather than spread or "laid." When the defects are in existence, however, it is to their elimination by the readiest means that attention must be turned.

A surface which is seen to be crazed with a network of fine cracks, probably originating in the undercoat, can never be made sound by cutting out and stopping. Even if this process is conscientiously performed, the stopping is liable to minute shrinkage when drying out, leaving a condition little better than the original, and even if circumstances are so favourable that this does not occur, the different texture of the filling material is bound to be apparent through any coating of colourwash which may be applied. Provided that this cracking is confined to the rendering material (as it usually is) and does not originate in movement of the basic structure—as may be the case in building of clinker blocks or slabs—the most effective simple cure is the application of a coat of cement slurry either by brush or spray, which will cover and partly fill the cracks. For this purpose "Supercement" has proved very satisfactory in several difficult cases, as it sets with an impervious skin throwing off water and preventing percolation through any unsealed cracks, which might disturb the rendering or its slurry top-dressing. "Supercement" has an unpleasant greenish-grey colour, even more dismal in appearance than ordinary Portland cement, but it forms an excellent surface for lime-white or distemper finish.

Alternatively, a good liberal coating with one of the proprietary stone paints will frequently succeed in obliterating the "crocodile" effect of crazed cement coating, and will seal the cracks against penetration for a considerable time.

Cases of continual movement of building *structure*, such as have arisen from the use of poor clinker blocks or slabs liable to expand or contract with change of moisture-content, can never be cured, but only palliated by such measures as have been described under "Dampness" for external treatment, and internal lining by battens and wallboard or plywood.

Cement Paving. — The irregular cracking of surfaces of cement paving may be prevented by precautions which are now familiar. Cracking which has occurred can only be accepted, and repaired by ordinary means.

The tendency which cement paving often shows to "dust up" under wear can, however, be countered by relatively simple means. If the floor is chemically clean (e.g., not oily or otherwise permeated) it can be brushed over at intervals of 24 hours with a solution containing 30.5 per cent. of neutral sodium silicate diluted with about four times its volume of water, until it fails to absorb more.[1] This treatment has been successfully used on dairy floors, where dusting-up is particularly obnoxious, and attack by lactic acid appears to induce it.

FUNGAL AND INSECT ATTACKS

Floors. — No house honestly built from an architect's specification and under careful supervision should (in ordinary circumstances) develop dry rot or other fungal decay, the manner of inception of these troubles and the precautions proper to avoid them being now so well known. Nevertheless, circumstances do arise when defects due to such causes occur. For example—a house normally warmed and ventilated may be unoccupied and closed during unfavourable weather conditions sufficient to produce that state of moist stuffiness in which latent spores can develop. Or an occupant of the house may block air bricks, build up garden beds or permit growth so as to obstruct them, raise levels above the damp-course, or permit unnoticed leakages to saturate portions of the structure.

Precautionary measures against dry rot have been referred to in earlier notes, and a good deal of information from B.R.S. and F.P.R.L. has been issued from time to time. Trouble most frequently arises in the case of boarded floors laid direct on concrete on the ground, and this class of defect is discussed in B.R.S. Notes, 2nd Series, Nos. 55, 195 and 198. Briefly, the only cure and preventive, where trouble has occurred, is to remove the affected flooring, including joists or battens, etc., and to form an impermeable membrane over the concrete with bituminous coating, upon which creosoted battens can be laid. It is wise also to brush-coat the underside of new flooring with a preservative. The suggestion is made by B.R.S. that in a small room the battens can be formed into an independent frame so as to avoid the necessity of puncturing the bituminous coating—this would apply to most houses. It is important to remember (1) that all infected or suspected timber should be removed and immediately burnt; (2) that half-measures, such as a thin coat of bituminous paint or tar on the oversite concrete, are merely futile.

In the case of ordinary joist and boarded floors, underfloor ventilation should be closely scrutinised when relaying, bearing in mind the need for *circulation* of air; inlets without outlets which will secure passage are almost useless. Another point to be assured of is that airbricks do not encourage the entry of driven rain. Skirtings should be examined, and removed if they are found to have been infected by growth from a rotten floor.

Dry Rot in Joinery.—Dry rot is by no means confined to floors, though that is the commonest position in which it appears. It is liable to affect panelling, plywood, and wallboard made from wood pulp. A case of dry rot in oak panelling is discussed in B.R.S. Notes, No. 260, 3rd Series, and the recommendation of F.P.R.L. is, briefly, that after removal of all infected material the wall should be cleaned with a blowlamp flame and then painted with a liquid capable of destroying any dry rot infection present. New fixing grands should be thoroughly treated with a wood preservative *after* having been cut to size, and the back of any panelling replaced should be planed, treated with an aqueous preservative, and after this has dried given two coats of aluminium paint. The space behind the panelling should have provision made for its ventilation — holes through the bottom rail and slots in the capping, with provision also for

1 B.R.S. Notes, 1st Series, No. 29.

passage of air past any battens which might seal compartments, are usually sufficient.

Roof-boarding, particularly the boarding below flat roofs, is subject to fungal attack if moistened by slight leakages — particularly if painted below. A case of this sort is described in B.R.S. Notes, 3rd Series, No. 244, and it may be feared that such troubles will become more common with the spread of flat roofing in everyday usage.

Mildew or Mould appearing on plaster is an after-consequence of continued dampness, and is not uncommon both on surfaces which have been papered or distempered—particularly when distempers used have a casein base. B.R.S. have reported on several such cases, and have recommended the use of mild disinfectants, after ordinary cleaning, so as to sterilize the affected surfaces before redecorating. Either methylated spirits or a 1 per cent. solution of formalin are effective, but incur risks. A 3 per cent. solution of zinc magnesium silicofluoride in water is said to be free from objection.

The source of the dampness should, of course, be sought and removed, and in this connection B.R.S. Notes, 3rd Series, No. 182, offer useful suggestions if the cause is not obvious. A cracked or blocked R.W.P. is one of the most frequent sources of dampness liable to produce this condition. The saturated state sometimes arising at the external angles of solid walling by double exposure often produces conditions favourable to the growth of mildew internally, especially in the corners of bungalow bedrooms, which are less freely opened to ventilation either by door or window than the average two-storey house. In any case, circulation of air is more sluggish in the angles of rooms, and it is in such positions that mildew is most frequently seen. Where an open flank wall permits, a supplementary window, even if not required for light, can do much to improve air circulation. In no room which has the possibility of windows on more than one side should this provision be omitted.

Destructive Insects. — The most familiar of our wood-consuming insect pests—the death-watch beetle—is not commonly met with in the timber of the average house, which does not afford scantlings of sufficient substance to give the grub comfortable harbourage. Actually, though the poet says: " What's in a name? " it may be hazarded that if this destructive insect had a less ominous-sounding name, such as " tick-beetle," its depredations would have attracted much less attention publicly, and caused much less (often needless) panic. The other wood-boring beetles, such as the ordinary furniture beetle and the powder-post beetle, are, however, not infrequently met with alike in softwood and in the sapwood of oak. These pests, of course, infest timber in the forest, and it is easily possible to import them (alive but dormant) in new timber, which may even remain in the work for months before the grubs or chrysalides emerge at the surface as fully developed beetles, when their exit holes are discovered. Careful examination of cleaned timber previous to use may sometimes reveal the tunnels made by the grubs where they are cut through laterally, these appearing then in the form of grooves, and it is wise to reject any timber showing such evidences. These, however, are easily overlooked, and when bisection chances to be transverse it is only too common for the pinhole to be choked with wood-dust so as to be almost invisible at the time.

Repeated inquiries reach B.R.S. and F.P.R.L. as to measures which can be taken to expel insects and prevent their recurrence, and a recent Note gives useful information on this subject.[2] Strip-oak flooring has often been the means of introducing Lyctus beetles, and this type of boarding should only be obtained from well-established suppliers who will guarantee it as stoved and free from infec-

2 B.R.S. Notes, 3rd Series, No. 268.

tion. Once the trouble has arisen it is only possible to remove and replace any wood reduced to a powdery condition, and to give repeated brush treatments with one of the proprietary preparations suitable for the purpose. These applications should be renewed at intervals as long as any bore-dust continues to emerge from the tunnel-exits. A preparation which does not discolour wood or stain plaster should be chosen, and it must be remembered that a strong and unpleasant smell may persist for some time, so that plenty of ventilation during and after treatment is desirable.

EFFLORESCENCE

The occurrence of noticeable efflorescence on the exposed surface of brickwork or plaster is always disfiguring, and may have more serious consequences. The frequency of the trouble may be judged from the number of inquiries which have been dealt with by B.R.S.[3] Briefly, the trouble is unpreventable once it has appeared, and effort has to be directed to its speedy removal. When it occurs on brick facings, which is invariably after saturated walls have been subjected to warm sunshine, bringing the dissolved salts in the bricks or mortar to the surface in crystals, the simplest and best treatment is to brush off the dry crystals at regular intervals. The efflorescence will gradually diminish, and this can be expedited by alternately soaking, drying and brushing repeatedly, if the trouble is considered sufficiently severe to merit such treatment.

Internally, efflorescence often destroys decorations on brick or plaster, but its recurrence after initial drying is complete is less usual. A common waterbound distemper (non-washable), or omission of any coating to the new plaster to the end of at least six months from occupation is a wise precaution.[4] This allows moisture which is in the work to dry out gradually. Brushing, as advised for external work (but without alternate washings) will disclose whether the trouble is diminishing; if it fails to do so the source of continued presence of moisture should be sought.

More serious are the cases, already referred to earlier in these notes, in which heavy glass-like crystals form on the interface between brick and plaster, pushing the latter off the wall, and in some cases disintegrating the brick. Such cases involve removal of plaster, and possibly of badly affected bricks, and re-execution of the work so disturbed. They are fortunately infrequent, but bricks burnt with poor slack (and even with destructor refuse) as fuel should be avoided at all costs, as sulphur components are apt to be present and produce these unwelcome results.

Efflorescence is also sometimes troublesome on red floor tiles, and occasionally on roofing tiles. The application of a red polish may serve to check and disguise floor-efflorescence; when this trouble arises on roofing tiles no cure is possible.

MINOR DEFECTS

It will most often be the case that well-built houses survive their maintenance period of six months without displaying any of the more serious defects hitherto mentioned. It is, however, very seldom that this term passes without the occurrence of a sprinkling of minor defects, which can be more or less troublesome to architect and builder according to the mental attitude of the owner—or his wife. It is not solely with the idea of allowing such defects to exhibit their full development that haste in dealing with them is to be deprecated, though that is a sufficient reason; as Mr. Bulkeley Creswell has wisely and wittily said elsewhere: "In six months' time the fly stuck on the paintwork of the drawing-room door will have assumed proper proportion."

3 B.R.S. Notes, 1st Series, Nos. 3, 60, 123, 26, 138, 40, 91, 92, 64, 70; 2nd Series, Nos. 15, 30, 71; 3rd Series, Nos. 138, 160, 166, 193, 227, 230, 232 and 255.

4 B.R.S. Notes, 3rd Series, No. 193.

Shrinkage of Joinery.—Such precautions against undue shrinkage as it is possible to take have been mentioned under the appropriate trades. Notwithstanding this, it is inevitable in conditions favourable to shrinkage that a certain amount must arise, and when this is not excessive, and occurs in painted woodwork properly designed, it is easily overcome by stopping, touching-up and recoating. It is difficult, however, to convince the layman that, given "well-seasoned wood," *any* visible shrinkage should be allowed. Perhaps an instance such as one recently observed would serve to do so. In this case the pine panelling of a dining-room which had been in position since some time before 1700, but papered over since 1858, was exposed, cleaned and painted in September, 1937. In July, 1938, most of the wide panels showed bare wood up to ⅛in. where they had pulled out from the grooves next to one stile or the other, due to shrinkage which could only be attributed to the installation of central heating, combined with the abnormally dry spring, together substantially reducing the moisture content of the timber after more than 200 years in use.

Plaster Cracks. — A few such defacements almost inevitably arise in the process of drying out and settlement. Those which do not originate in structural defects are habitually repaired by stopping with Keene's or similar quick-setting material. This practice gives fairly good results where a trowelled finish has been applied to the surface generally, but is a complete failure when related to any textural finish. In such circumstances further treatment should be applied, which may offend the trained plasterer or painter entrusted with the work, but will give superior results. A method which has proved successful in rendering stopped cracks much less visible is to press damp sand (of equal coarseness to the plastering material) well into the stopping freshly applied, using sand freely and in amply quantity. Orthodox methods may, in fact, be supplanted by such devices as ingenuity suggests to reproduce the texture of the surroundings.

Paint Defects.—Most defects in paintwork are caused by bad conditions, hurried work, or cheap materials, but occasionally by indifferent workmanship apart from these special conditions. A word of sympathy must be spared for the painter. Commonly, when he appears work is so nearly approaching completion that he is urged forward—given, very likely, a time limit—and compelled to work when weather, dusty atmosphere, the presence of odd-job men or similar drawbacks would render it wiser to desist.

Under modern conditions paint is usually supplied ready made, and it is always wise to acquaint the manufacturer with the purpose for which it is intended, and to employ undercoats suited to the finish proposed. Paints differ greatly in "workability" and spreading power, and it may be suspected that indifferent results not infrequently arise from misguided efforts of the painter to increase workability by the addition of thinners. This practice, which was relatively harmless with paints mixed on the job mainly with linseed oil, white lead and turps, becomes dangerous to quality of result in the case of synthetic and cellulose paints, and of proprietary products generally, which may be quite satisfactorily used as received, but are liable to disappoint if variations or additions are made, employing materials which may quarrel with components which are unknown.

Paint applied to Columbian pine joinery sometimes shows a tendency to peel and to be penetrated by exudation of resin. If the priming coat on this material is aluminium paint the trouble should not arise.

Paint and distemper failures on plastered surfaces are usually due to conditions in the plastering to which they have been applied, a subject already discussed.

Miscellaneous Defects Due to Sheer "Cussedness."—The most irritating of all defects are, of course, those which can only be ascribed to ill-luck, of which a few instances must suffice —merely to show how the architect making his final inspection may need to exercise the deductive powers of a Sherlock Holmes to arrive at the cause of manifestations which at first appear simple.

An apparent serious leakage in a roof was found to be due to the drip from an expansion pipe on the hot-water system, the pipe having been forced from its position over the cold tank by some exploring person.

A moist patch above the skirting in a ground-floor room (ascribed to a defective dampcourse, as *all* such things are!) was found to be due to the supply of lime plaster mixed for the job having given out just short of completion and having been supplemented by the plasterer by a small area of cement and sand on which condensation formed.

A patch of quarry tile paving inexplicably risen from its bed so as to sound hollow when tapped was found to lie full in the sun. The inference was drawn that being tightly laid with no appreciable width of joint, expansion had caused it to rise off its screeding. On an occasion some years ago, when measuring at Warmington Church, Northants, the writer was startled by a loud crack followed by a tinkling sound, and on investigation found that a portion of the tile paving of the south aisle had literally "blown up" where the rays of hot sunlight fell upon it through the open south door.

A room door lock which resolutely refused to latch though apparently in perfect order was put right by trifling adjustment of the striker, which had been fixed in the jamb-lining no more than a hair's breadth too high, so that the latch could not enter and engage.

A mysterious draught complained of by occupants of the fireside recess was found to enter *via* the cavity and the trifling shrinkage space round an oak beam which entered the wall and extended to this aperture.

SUBJECT INDEX

NOTE.—References to Building Research Station and British Standard Specifications are so frequent in the text that index page numbers would be valueless.

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